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AN EMPIRICAL STUDY ON THE USE OF STRAIGHT ALCOHOL FUELS PREPARED FROM FEEDSTOCK INCLUDING BARLEY, WHEAT, AND POTATOES

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AN EMPIRICAL STUDY ON THE USE OF STRAIGHT ALCOHOL FUELS PREPARED FROM FEEDSTOCK INCLUDING BARLEY, WHEAT, AND POTATOES

Prepared by

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September, 1980

Prepared for

Montana Department of Natural Resources and Conservation
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Inception of this study took place in April, 1980 and the research was conducted over a five month period. As a traditional empirical study, this project was conceived and successfully carried out as a demonstration of a small farm-sited stilling operation using wastes as a heating source, using waste crops as a feedstock and actually operating farm equipment on the resulting produce.

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....

Grant Committee: Daniel Miles,
Stacy Young,
William G. Dratz, Chair

....

August, 1980

LAKE COUNTY RESOURCE RECYCLING COMPANY
AGRIFUELS OF AMERICA CORPORATION
Box 679 Polson, Montana 59860

table of contents

1

List of Illustrations 4
EtOH System Block Diagram 6

A. INTRODUCTION AND BACKGROUND

A.1 Brief Description of Work 7
A.2 Operation of 100/gal day Still . . 13
A.3 Brief Analysis of Market 13

2

B. FEEDSTOCK SURVEY

B.1 Properties of Feedstock 16
B.2 Types of Feedstock in County . . . 16
B.3 Issue of Grower Selectivity 21
B.4 Crop Residues and Forage 22
Summary of Feedstock Suitability Chart . . . 23
B.5 Factors Related to Acreage Yield . 24
B.6 Coproduct Yields 25
Sugar Beet Growing Areas Map 27
Lake county Feedstock Map 1 28
Lake county Feedstock Map 2 29
Lake county Feedstock Map 3 30

3

C. E·H·S·S FACTORS

C.1 Areas for Potential Hazardous Environmental Effects 32
C.2 EtOH Production Effects 32
Crop Residue Removal 32
Wet Stillage 33
Air Pollution 33
C.3 Use as Farm Fuel 34
C.4 Health Considerations 37
C.5 Socioeconomic Factors 38
Specific Socioeconomic Goals 41
C.6 Specific County Demography 42
County/State Map 42
Population by Age/Sex Chart 42
Population by Size of Urban Centers 43
Per Capita Income Chart 43
Unemployment Chart for 1978 44
County Poverty-Impacted Areas 44
Lake County Economic Data 46

4

D. PLANT TECHNOLOGY

D.1 Description of Typical EtOH Plant with Schematics 48
Schematic of Feedstock Handling 48
Schematic of Fermentation Process 48
Schematic of Distillation Process 49

Schematic of Coproduct Handling 49
D.2 Block Representation of Ethanol Production 50
D.3 Description of Still Used . . 50
Block Representation Chart 51
D.4 Description of Proposed "Eagle Still" 52
"Eagle Still" Side-view Illustration . 53
"Eagle Still" Equipping List 54
D.5 Basic Recipe Used in Study . . 55
D.6 Enzymatic Hydrolysis 56
D.7 Features of Enzymatic Hydrolysis Plant 56
Exploded Side-view of Typical Plant . . 57
D.8 Cost Breakdowns of Stills . . 58
D.9 Overview of Budget 59
"Eagle" Operational Budget 60-62

5

E. OUTCOMES

E.1 Concluding Statement of Work . 64
E.2 Scope of Work Completed . . . 65
E.3 Work that Remains and is Proposed 68
Summary of Outcomes 71
E.4 Projected Income and Expense Statement 72
Income and Expense Projection for "Eagle Still" 73
Personnel/Financing Flow Chart 74

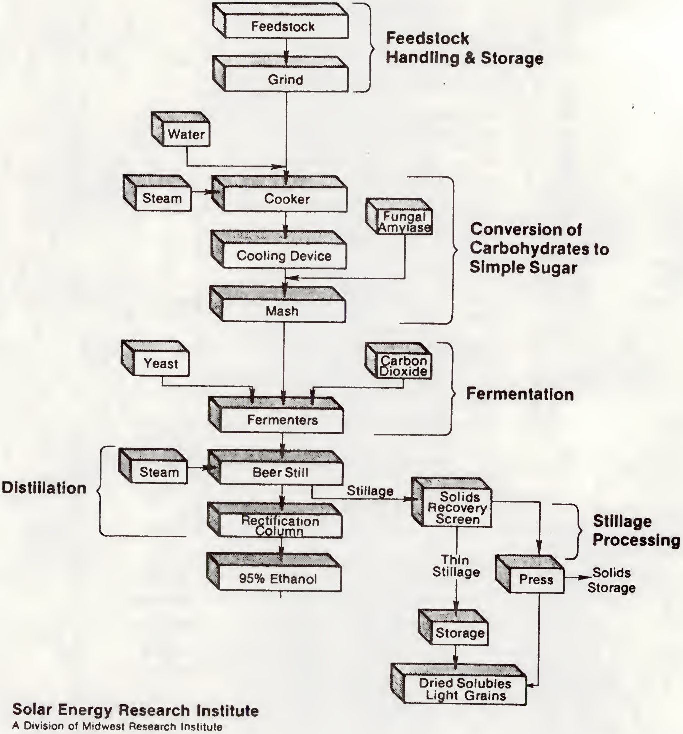
6

F. APPENDICES

A Checklist 76
B Observation Logs 77-83
C Floorplans 84-86
D Digest of Sugar Beet Prod . . 87
E Digest of Potato Production . 88
F Hern Cooperative Agreement . . 89-90
G Notes on Enzymatic Hydrolysis 91-96
H Corporate By-Laws 97-
I Articles of Incorporation . . -105
J Personnel Vitae 106-107
K Spectator List fr Open House . 108-111
L Local Press Coverage 112-116
M Organization/Personnel Chart . 117
N Modification Guidelines for Conversion of Motors 118
O ASCS Figures for Agricultural Production for Lake County -- Year 1979 119-20
P Feedstock Charting 121-23

ILLUSTRATIONS ENCLOSED

		Page No.
No. 1.	Ethanol Production Block Diagram	6
No. 2.	Summary of Feedstock Suitabilities	23
No. 3.	Feedstock and EtOH Yields	24
No. 4.	Sugar Beet Cultivation Areas Map	27
No. 5.	Lake County NW Overview Map	28
No. 6.	Lake County Central Overview Map	29
No. 7.	Lake County South-Central Overview Map	30
No. 8	Lake County/Montana Map	42
No. 9	Chart of County Population by Age and Sex	42
No. 10	Population of Urban Centers and Rural Areas	43
No. 11	Per Capita County Wage-earner Income, 1969 and 1975	43
No. 12	Lake County Unemployment Figures for 1978	44
No. 13.	Map/Diagram of Lake County Poverty Impact	44
No. 14.	Ethanol Production Flow Chart	51
No. 15.	"Eagle Still" Artist's Rendering	53
No. 16.	Enzymatic Hydrolysis Plant Design	57
No. 17	Schematic No. 1, "Feedstock Preparation"	48
No. 18	Schematic No. 2, "Fermentation Process"	48
No. 19	Schematic No. 3, "Distillation Process"	49
No. 20	Schematic No. 4, "Coproduct Milling"	49
No. 21	Chart of Financial/Staffing Structure	74
No. 22	Personnel Chart	117



Ethanol Production System Block Diagram

Illustration No. 1

A. INTRODUCTION AND BACKGROUND

A.1 Brief Descriptions of Work Undertaken

First, an empirical study was carried out to actually erect a small 100-gal/da sized still and experiment with agricultural feedstock left over from the potato harvest and marketing period of 1979-80 and to site the still in fixed-place on the Hern Farms, Inc. farm about 11 miles south of Polson.

Secondly, and as important as the first measure, extensive research was made as to what it would take in terms of engineering and economics to erect and utilize a larger 600-800/gal. day still starting in the spring of 1981 and carrying on thereafter. Several goals were incidental to this task:

- develop a conservatively-rated "Income and Expense Statement" as a projection taking into consideration revenues, cost of good sold, labor costs and plant burden costs
- develop an analysis of the types of fueling sources available, comparing propane to waste woods, and figure out cost-to-benefit ratios

- develop a contractual cooperative agreement with the Hern Farms, Inc. for the purpose of placing a stilling unit on the Hern farm which would produce that farm's fuel needs for the production year 1981-82, and partly 1980-81
- develop a recipe for the use of sugar-imbinded starches utilizing enzymatic hydrolosis and develop conclusions
- develop, prepare for and carry out an actual demonstration of alcohol fuel production before the public and use the resulting fuel produced in farm equipment at the demonstration
- identify area resources in the form of chemistry and agricultural laboratories which would analyse and grade fuels and process coproducts
- develop public awareness among the farming and ranching public as to the potential beneficial impact of the conversion to straight EtOH fuel for farm production
- develop a business plan
- develop a concept for handling and preparing for market and marketing EtOH fuels
- develop a concept for handling and perparing for market and marketing process coproducts (CO_2, mash residues, et al.)

Our "Income and Expense Statement" is included in Section 4, entitled "Outcomes" and indicates that with the "Eagle" still (a portable still of our own design elsewhere depicted) could produce 130,000 gallons of EtOH per year, 142,500 lbs. of CO_2 per year, 40,000 bushels of feed and 10,000 hundred-weight of potato-based feed per year, to net $130,000 from fuel sales, $4,375 from impounded CO_2 sales, and

$150,000 from feed sales. These were calculated with a factor of $1.00/gal. as the fuel sale price, 1980 feedstock per unit cost figures, CO_2 at .03¢/lb. and mash coproduct for feed figures the same as purchasing costs (for barley, $3.00/bu; for potatoes, $1.00 HW (waste potatoes)). The cost of yeasts and enzymes and other process chemicals were figured in. Labor costs at 10,000 stilling manhours per year were figured (3 full-time and 2 part-time workers), maintenance costs reflected as time-valued down time, and the plant burden considered as depreciation of $100,000 over a five-year period. Fuels costs were estimated at $960 a year for electricity (not as the primary boiler fuel), and $5,000 for the year in fueling costs, consuming slightly under 400,000 Btu an hour. It is considered that handling wood waste as a boiler hog-fuel, or forage- or crop-residues as a hog-fuel, would be nearly the same as the cost of propane (68¢ US gal. x 120 gal./day), or, between $4-5,000 per year. Wood waste and straw are identified as our fuel of choice. It is not accurate, however, to describe these as "cost free" since there are handling costs associated with their use.

The cost-to-benefit comparisons of the fuels consumed and the fuels produced can be viewed as follows.
In the case of propane, it would take 6,240 gallons a year to make 130,000 gallons of EtOH, 142,500 pounds of of CO_2, and 150,000 units of coproduct feeds. A dollar ratio in rounded off figures reflects costs-to-benefits emerging as:

$$4{,}243 / 130{,}000 \longrightarrow 9 / 254$$

A ratio of 9 to 254 is realized factoring propane at 68¢ per gallon and the resulting EtOH at a consumer price level of $1.00 per gallon. Our view is that handling wood- and forage-wastes would create manhours which would result in a net cost similar to utilizing propane as a fuel. This analysis does not justify using propane, a depletable resource. This analysis, however, does peg propane as a short-term cost-effective fuel for EtOH production. Solar drying is proposed as the heating source for thermal drying of mash coproducts to bring them up to a dried handling form.

A cooperative agreement was formed with the assistance of legal counsel with which to proceed to develop the Hern farm near Polson as Montana's first major producing farm to be fueled on EtOH by the production year of 1981-82. This document is attached in the Appendices as Exhibit F, "Cooperative Agreement".

A recipe for distilling EtOH from both barley and potatoes was developed and is being refined. They are enclosed under Section 4, "Plant Technology", and are authored by Rick E. Van Voast. "Notes on the Conversion of Starches by Enzymatic Hydrolosis" is attached in the Appendices as Exhibit G.

A farm demonstration was held using produce made from the still which we erected in May. It was attended by 175 area farmers, ranchers and interested spectators. On hand were the Lieutenant Governor, staff from the Montana Department of Natural Resources and Conservation, Montana Department of Agriculture, US Department of Agriculture, Agricultural Stabilization and Soil Conservation Service, the County Extension Service, the Community Development Corporation, representatives from the Tribal Council of the Confederated Salish and

A.1 cont.

Kootenai Tribes of the Flathead reservation, the Lake County Potato Growers Association, county 4H clubs, several law and accounting firms, several candidates for public office, the Polson Stove Shop, Endless Energy Company, Big Sky Fabricators, Malone Irrigation, et al. A full list of spectators (those who signed the guest book) is attached in the Appendices as Exhibit K. News stories which describe the event are attached as Exhibit L.

The Chemistry Laboratory in Bozeman at Montana State University has been identified as the laboratory which will provide cost-free analyses of produce and co-products generated by our production. We have yet (as of September 1, 1980) to use their services although we have sealed containers on hand of some of the produce which we distilled during May through September. This service is provided on a cooperative basis with the assisting efforts of the Lake County Extension Service and its agent, Ed Bratten.

More public demonstrations are planned. In addition a systematic follow-up is planned to contact the individuals who appeared at our publicized demonstration. In the not-too-distant future we plan as our major form of public advertising driving vehicles about the county identified with affixed signs as "powered by alcohol fuel". We are also negotiating several half-hour special programs to be broadcast over area television. Slide and videotape productions are also contemplated with William Dratz, a video programmer, and Stacy Young, public relations director, directing.

A business plan has been formed in rough outline form and during the next grant-phase, depending on the specifications of the final erected larger capacity "Eagle" still, a more formal business plan in "presentation form" will be developed with the help of a consulting economist.

The EtOH so far produced has been in small enough quanities so that it could be denatured and stored in 30-gal drums. In so far as production utilizing the "Eagle" still is concerned, larger containments designed in areas of restricted access will be in place. Such containments will be constructed of new generation poly-fiberglasses or stainless steel. Hilton and Leonard Hern have agreed to purchase $30,000 worth of potato alcohol during 1981-82. Van Voast farms will purchase roughly 30,000 gallons and the rest will be marketed. Plans are being made to see if EtOH production can be integrated into the ASCS livestock feed potato purchasing program which bought 50,000 hundredweight of potatoes during the 1979 production year which did not go to market as seed potatoes or as food for human consumption. Mr. Hern was one of five area farmers who participated in that program that year. US government programs to buy 170P to 190P EtOH will also be used. The market outlook is very favorable.

AfuelsCORP proposes to set up a mash coproduct handling process in building 2 of the "Eagle" floorplan (see Appendix, Exhibit C). The Van Voast hog farm proposes to utilize barley coproducts (an 800-hog operation). The George Eye ranch in St. Ignatius also proposes to use some of the processed, nutrified feed. The ChemLab in Bozeman will be utilized to determine what nutrification will be involved to create a stable and viable feed product or products. Markets also exist for distillers' grains and syrups.

A.2 Operation of the 100-gal/da. Still

Operation of the smaller still used in the feasibility and empirical study grant phase was carried out as depicted by running observation logs and summaries as recorded and attached as Exhibit B, in the Appendices.

The fermentation tanks consisted of 2 600+ gallon tanks with intake and outtake piping and fitted with reostat thermometers. Agitation was accomplished with a central pump capable of pumping heavy mash slurries with temperatures 140° and below. The still was capable of producing 120 gallons per day, according to manufacturer's specifications; we reached an average hourly production rate of 8 gallons per hour of proof alcohol ranging from 155P to 195P. The still was fitted with reostat gauges. Wood wastes were used as a heating source. The mash coproducts were not used as feed and CO_2 was not impounded.

A.3 Brief Analysis of Market

Although touched upon earlier, the marketing potential of fuel alcohol deserves more attention.

Illustrative examples of the applicability of EtOH in the region would be helpful. The city of Missoula, about 45 miles from the Hern still and proposed site for the "eagle" still has an urban transit system known as the "Mountain Lines"; this bus system features a number of new Mercedes Benz buses built in Brazil and originally equipped to run on straight alcohol fuel. The buses currently run on diesel. The illustrative key here is that fleet buses owned by municipalities, mass transit districts and school districts are likely candidates for conversion in the future. The economics of conversion are subjects for separate studies by the economists and accountants and public trustees of these vital services. A stable, cost-level source of fuels which aren't polluting and which infuse additional dollars into the local agricultural economic base is demonstrably in both the public and national interest.

Our marketing plan is to use a checklist (Appendix, Exhibit A) to help the farmer arrive at a reasonable estimate of the amount of crops he could raise to produce the fuels he wants at a price he can afford and without deflecting crops and produce away from markets which channel produce destined for human consumption. The beauty of our marketing plan is its simplicity. We plan to both distill a farmer's set-aside produce on his land and store the resulting EtOH on his land by using the portable "Eagle" still as well as deliver fuels to farmers by tanker truck.

A feature of our marketing plan is the decided goal of setting a level price, that is, of setting a price and keeping the price level for at least one production year at a time. We plan to have escalators and deescalators built into jobber fuel delivery agreements.

B. FEEDSTOCK SURVEY

This survey describes the properties and applicability of the full range of potential agricultural feedstock which is or could be cultivated in the lower Flathead valley in Montana. The survey also depicts the extents of present acreage under cultivation in the form of maps and data provided with the assistance of the Agricultural Stabilization and Soil Conservation Service (ASCS) of the US Department of Agriculture, whose local office is in Ronan. Conservative estimates are also provided with respect to tonnage of waste and excess crops which didn't go to market, based on the past 3 years' experiences, and projected based on that experience as currently available.

B.1 Properties and Applicability of Feedstock

Hereunder are described the types of produce and crop residues suitable for feedstock, data on the yields of the three principal coproducts derived from the fermentation of these feedstocks, and economic considerations factoring into selecting and utilizing any one stock to produce EtOH.

B.2 Types of Feedstock in the Lake County area

Fermentation of six-cardon sugar units, principally glucose, is the biological basis by which EtOH is produced. All agricultural crops and crop residues contain 6-carbon sugars, or compounds and bases of these sugars, and are suitable for biomass conversion to produce EtOH. Three different constituencies of the basic sugar bases are possible, being: starch crops, sugar crops and lignocellulosic residues. In the instance of starch crops and lignocellulosic residues, six-carbon containing bases must be changed into simplified six-carbon sugar compounds before fermentation into beer can proceed.

B.2 cont.

Sugar Crops. In sugar crops, the larger number of 6-carbon sugar units occur molecularly in bonded pairs. Once a sugar crop has been milled to extract the base sugar, no additional processing is required before fermentation is started since Saccharomyces cerevisiae readily acts upon the pre-milled and cracked bases.

Low equiping/labor and manufacturing costs, as well as relatively low heating requirements, are the attractive features of sugar crops. The major disadvantage present is spoilage of the slurry because of contamination, feedstock storage problems prior to processing, as well as the possible inadvertant culturing of contaminating organisms while fermentation is underway.

Sugar crops are mostly grown in warmer climates such as in the regions of California, Louisiana and Puerto Rico and consist of sugar cane and aclimated sugar beets. Other produce include sweet sorghum, Jerusalem artichokes, fruits and, as mentioned, fodder beets.

AfuelsCORP rules out the use of sugarcane for obvious reasons. In passing, it is worthy to note that the sugarcane farming industry of Brazil has experienced a total industry-wide rejuvenation and revitalization due to Brazil's national mobilization to convert the country to alcohol fuels, with a small margin forgasohol.

A good feedstock is aclimatized sugar beets and, being such, they are a more versatile crop when compared to sugar cane. Sugar beets are cultivated in nearly half the states and their cultivation potential for more states is projected as high because varietal sugar beets tolerate a wide range of climate and soil conditions. Another advantage is the sustained high yield of coproducts such as beet pulp and tops, usable as EtOH-process livestock feed (perhaps when nutrified) or organic fertilizer as ground spread, and as countererrosive ground cover.

Wholesale increases in cultivation of sugar beets is necessarily limited by the need to rotate with nonroot crops, in order to lower losses by nematodes, a parasite. The general guideline of one beet crop per 4-years period is best and is observed industry-wide. No residues or coproducts are suitable for hog- or boiler-fuel.

A map of Lake county illustrates the acreage which is presently under cultivation in sugar beets, as well as portions of land areas which used to be under cultivation until widespread beet cultivation ceased about a decade ago. (See Illustration No. 4, "Sugar Beet Cultivation Areas").

Jerusalem Artichokes. At present no Jerusalems are known to be under cultivation in Lake county. The crop, however, has demonstrated excellent potential in this climate as an alternative sugar crop. A member of the sunflower family, this crop is native to North America. As such, Jerusalems are well adapted to northern climates. Lake county, being a protected agricultural high-country plateau with a seasonal higher-average warm temperature than other Montana farming regions, would be ideal for Jerusalem Artichoke cultivation. Like the sugar beet, the Jerusalems produce sugar in the top growth and stores it in the roots and tuber. They grow in a variety of soil and fertility conditions. Being a perennial, small tubers left in the field will produce the following season's crop, so no plowing or seeding would be needed.

Jerusalems have traditionally been grown for the tuber. But an alternative to harvesting the tuber exists. Incoll and Neales have noted that the best part of the sugar produced in the leaves does not enter the tuber until the plant has nearly reach the end of its full life cycle ("The Stem as a Temporary Sink before Tuberization." Helianthus Tuberosus L. Journal of Experimental Botany 21. (67); 1970; pp. 469-76.). It would be possible, therefore, to harvest the sugared stock, the stem, and avoid harvesting the tuber. In this respect, harvesting is essentially like harvesting corn for ensilage.

Fodder Beets. Beets used to be grown aplenty in this region when a major sugar refining mill operated in Missoula. The Arlee area was extensively under cultivation, as depicted in the map

Illustration No. 4. The fodder beet is a high yielding forage crop obtained by crossing two other beet species, sugar beets and mangolds. Its agronomic characteristics are similar to sugar beets. The attractions of this crop are the higher yield of fermentable sugars per acre (see table elsewhere below) and its high resistance to loss of sugars during storage. These impacts are spoken to in depth by Earl and Brown, before the Third International Symposium on Alcohol Fuels Technology, 1979 ("Alcohol Fuels from Biomass in New Zealand: the Energetics and Economics of Production and Processing", by W. B. Earl and W. A. Brown, before the Third International Symposium on Alcohol Fuels Technology, the proceedings, Vol. I, pp. 1-11; May 28-31, 1979).

Appendix D is a Digest of Sugar Beet Production in Lake County, compiled from various sources. The appendix speaks of the past experiences of beet farmers in the region.

Fruit Crops. These are another in the sugar crop catagory (cherries, apples, etc.). In other regions of the nation, fruit crops are used extensively as the feedstock for wine and some brandy production. These crops aren't likely in those areas to be used for EtOH production due to their high market value as beverege alcohol feedstock for human consumption. In this Montana region, however, commercial winemaking and distilling of wines into brandy and liquers has not begun. There is some extent of seasonal waste of the Flathead Lake region cherry crop (usually between 15-20% of the whole crop) due to hail and rain damage and marginal insect and bird damage. To illustrate the value of even these waste crops, a major local producer has installed brine tanks and is processing split and slightly damaged cherries for use as the eatable kind found in canned fruit cocktail. There is some question as to whether the brine can later be fermented and distilled and this remains a research question being explored by AfuelsCORP. Due to the extensive handling problems, transportation expenses and storage problems, as well as the lack of comparable coproducts, cherries and apples (the two principal fruit crops in the county) aren't a viable and economic feedstock, except perhaps for an orchard-sited small distilling operation.

The county map(s) contained in this section depict orchard areas in the county.

The suitability of fruit as a feedstock is subject to more research and we aren't closing our minds on the question. It must be viewed, however, on a scale of comparable value and, as such, as a competitive feedstock is not as productive as fodder beets or Jerusalem Artichokes, or starch crops.

Starch Crops. Most of the 6-carbon units are linked together in long, branched chains called starch. Yeast cannot use these sugar-binding chains to produce EtOH. The starch chains must therefore be broken down into individual six-carbon units or groups of two units. The conversion of Starches by Enzymatic Hydrolysis, both the process and AfuelsCORP experiments, are described in detail in Appendix G, "Notes on the Conversion of Starches by Enzymatic Hydrolysis Using AfuelsCORP Still No. 2". The starch conversion process is relatively simple because the bonds in the starch chains can be broken by the combination of heat and enzymes, or by a mild acid solution. AfuelsCORP utilized the combination of heat and enzymes, described in detail in Appendix G.

There are advantages and disadvantages in using starches, mainly potatoes, to produce EtOH. The main disadvantage is the use of additional equipment, additional labor and the energy costs associated with heat generation which taken together cause the breakdown of the starch chains into individual sugar units which can be acted upon by Saccharomyces cerevisiae. However, these costs can be absorbed through efficient division of labor during the time of year when potatoes are sorted for shipment to points west (in the spring) and by and large through an extension of the time commitment to shipping potatoes in the spring. To illustrate, instead of the 3-4 weeks it might take to empty cellars and ship the produce, the time could be extended another 2 weeks with a skeleton crew of only a few workers to handle the added-on task of producing the fuel that will be used until the same time the following year. The principal advantage in starch crops is the relative ease with which they can be stored, with minimal loss of the imbinded fermentable sugars.

Ease of storage is related to the following factor: many microorganisms can utilize individual or small groups of sugar unit bases, but not long chains. Saccharomyces included. Some microorganisms present in the environment produce the enzymes needed to break up the chains, but certain conditions such as temperature, pH and moisture have to be optimal. Otherwise conversion could be slow, impediments could be introduced to arrest conversion, and so forth. When crops are dried or processed-reduced to nearly 12% moisture in produce mass -- the percentage at which microorganisms cannot survive -- the deterioration of starch, as well as constituencies of protein and fats, is minimal.

There are essentially two broad catagories of starch crops:

grains — wheat, barley, sorghum, corn

tubers — potatoes and sweet potatoes

The production of beverege alcohol from these types of starch crops is a well established practice.

The county maps contained in this section depict the areas under cultivation as certified seed potatoes. A history of county seed potato cultivation is contained in Appendix E, "History of Certified Seed Potato Cultivation in Lake County", as per various reliable sources including potato growers, the Potato Growers Association, and USDA data-gathering agencies.

B.3 The Issue of Selectivity for the Grower

A great deal of the agronomic research into feedstocks for EtOH production and livestock feed production are focused on crops such as sweet sorghum. However, emerging opportunities exist for the grain grower and the tuber grower who want to yield an increase in EtOH per acre. Selectivity is the key issue. The grower should recognize that new varieties of grain and tubers exist as a product of research. In terms of a food, in the case of wheat and in selecting a wheat variety, protein content is ordinarily emphasized. For EtOH production, however, high starch content is desired. It is well established that higher starch content grains produce more per acre and, as a direct outfall, more EtOH per acre.

B.4 Crop Residues and Forage Crops

Stalks and leaves of sugar and starch crops are made up mostly of cellulose. The long-chain imbinding problem present in starchy tubers is carried forward in complexity in terms of utilizing crop residues. The individual 6-carbon sugar units imbinded in cellulose are linked in extremely long chains by a more resiliant chemical bond than exists in starch.

As with starch, cellulose must be broken down into liberated sugar unit bases before Saccharomyces can be introduced, to institute fermentation. The process is decidedly more complex and costly than the process-breakdown of starches.

Breaking down the cellulose is complicated by the presence of lignin, a complex compound which structurally surrounds cellulose. It is this substance which compounds the complexity of pretreating cellulose for EtOH fermentation.

For these reasons, at the present time utilization of crop residues in terms of cellulose bases is not considered cost-effective. Research into this area, however, within the context of agriculturally-based sources of EtOH feedstock, other than cellulose from wood wastes in forests, is a matter of our intense interest and concern. Current research into cellulosic conversion may yet yield processes and treatments which may eventually be well suited to agriculturally-based EtOH production.

Forage crops, on the other hand, show promise for EtOH production. In their early stages of growth, grasses such as Sudan grass contain very little lignin and the conversion of cellulose to sugar is more efficient. These crops can be harvested 3 or 4 times a season and when cut as green chop may have the highest yield in terms of sheer bulk compared to dried material of any other storage crop. Process coproducts are livestock feeds and ground cover. Milling and hydrolysis of the linkages, again, is the principal surmountable problem. Alfalfa and grasses should by no means be written off as a feedstock due to cellulosic constituencies during their growing and maturing period.

Illustration No. 2

Type of Feedstock	Process prior to Fermentation	Advantages and Disadvantages	
Sugar crops (e.g. sugar beets, fodder beets, Jerusalem Artichokes, et al.)	Milling in Hammer Mill to extract sugar, light crushing	Advantages:	Minimal prep, high yield per acre, coproducts (feeds, etc.)
		Disadvantages:	Storage problems, cultivation practices not fully developed
Starch crops			
(Grains: wheat, barley, corn, etc.)	Milling, liquefaction and saccharification	Advantages:	Storage tech well developed, cultivation practices widespread, coproduct high in protein
(Tubers: potatoes, sweet potatoes)		Disadvantages:	Additional equipping and labor concerns, DDG from aflatoxin-contaminated grain not suitable as feed
Cellulosic			
(Crop Residues: wheat straw, corn stover, et al.)	Milling and Hydrolysis of cellolosic linkages	Advantages:	No impact on livestock feed market, widespread availability
(Forages: alfalfa, grasses, et al.)		Disadvantages:	Process undeveloped and unrefined

SUMMARY OF FEEDSTOCK SUITABILITIES

source: Midwest Research Institute, 1980

B.5 Factors Related to EtOH Yield per Acre

An estimate of yield per acre can be arrived at as long as several factors are taken into consideration. They are:

- the amount of fermentable compounds available (sugar, starches, etc.) prior to fermentation, based on hundred weight, tonnage, etc.
- the estimated loss of fermentable solids due to storage (as applicable)

The potential yield of EtOH is roughly one-half pound of EtOH for each pound of sugar. Taken into consideration by the processor is the fact that not all of the carbohydrate compounds become available to yeasts as sugars nor does the yeast convert all the sugar bases present during fermentation to EtOH. Therefore, for estimating purposes, one gallon of EtOH is yielded for each 15 pounds of sugar base, or starch, at the time the material is actually being fermented. It is difficult to estimate yields from cellulosic bases.

Depicted below are respresentative yields of some domestic major feedstocks based on their individual unit measurements.

Feedstock Type	EtOH Yield
Cereal grains	2.5 US gal/bu
Potatoes	1.4 US gal/HW
Sugar beets	20 US gal/T

Illustration No. 3

To illustrate the above measuring criteria, take the example of the Leonard Hern potato operation near Polson, Montana. In production year 1979-80, the grower had nearly 500 tons of waste potatoes, being 1,000,000 pounds, being in turn 10,000 hundred weight (HW) of potatoes. At this level of availability of feedstock derived from waste potatoes which did not go to market, Mr. Hern could have made an estimated 14,000 gallons of between 160P and 190P EtOH. Valued at $1.50/gal, his net monetary gain would have been $21,200. A standing 40¢/gal. tax credit for each gal. of 160P EtOH, as provided by the Windfall Profits Tax Act, would have netted an additional income feature of $5,600.

B.6 Coproduct Yields

Besides EtOH, the fermentation of 6-carbon sugar slurries with yeast results in the formation of carbon dioxide (CO_2) For every pound of ethanol produced, 0.957 pound of CO_2 is formed; stated another way, for every gallon of EtOH produced, 6.33 pounds of CO_2 are formed. This ratio is fixed and can be expressed by the chemical equation:

$$\underset{\text{(glucose)}}{C_6H_{12}O_6} \longrightarrow \underset{\text{(EtOH)}}{2C_2H_5OH} + \underset{\text{(carbon dioxide)}}{2CO_2} + \text{heat}$$

Yeasts are cultured as a coproduct of EtOH fermentation. And since yeast is an excellent microbial source for microbial contamination, it may represent a pollutant if dumped onto the land. A handling system for batching, packaging and storing yeasts therefore is desirable.

Starch feedstocks, the feedstock present on the Hern ranch, consist mainly of potatoes and some grains. The use of the residues with respect to these feedstocks is similar. In the case of grains, the mash which is first cooked, then fermented and further distilled is left over and contains the bulk of the whole grain. Once the EtOH is stripped off the cooking mash, the nonfermentable portion appears in the stillage. About three-quarters of the slurry mash is left over in the form of suspended, slurried particles ranging in texture from coarse to fine. The suspended, slurried mash is drawn off after stripping and dried in our solar drying beds. The coarser solids are tagged as distillers' light grains. The soluble portion may be concentrated to syrup form with suspended solids amounting to 30% mean, tagged distillers' solubles. When dried together, the resulting coproduct is distillers' dark grains. These coproducts are valuable as high-protein supplements for ruminants.

Presently the demand for usage of protein supplements exceeds the supply and the market outlook is good. Put simply, the treated coproduct can be used as a grain feed extender supplement and as an extender feature the extender itself features high protein and nutritive values. Straw can also be milled and mixed with this for a feed instead of mixing with hay or alfalfa.

B.6 cont.

Extensive grain processing is not feasible in our size operation but may be considered for the future. Entry into the feed markets is contemplated but entry into the wet-milling markets for glutens, etc. is not immediately contemplated. Some basic processes will be explored, however, including simple processing to separate starch from combined germ, fibers and glutens. The result is a doughy mass suitable as a meat-analog. This material can also be incorporated into baked breads, enhancing nutritional value by increasing the protein, fiber and vitamin (germ) content.

Coproducts can, therefore, be seen as both a livestock and human food source.

Yields as high as 1,000 lbs. per acre, equivalent to a conservative 140 bu. per acre of 12% protein wheat are possible.

Contained as Exhibit P following are charts depicting water, protein and carbohydrate content of selected farm products, energy content for feed, a typical anaysis of dried grain solids, starch/sugar percentages in grains and a basic comparison of raw materials for EtOH production, sourced from USDA's "Handbook of the Nutritional Contents of Foods", Midwest Institute and Solar Energy Research Institute's "Fuel from Farms", Distillers Feed Research Council's "Feed Formulation", National Academy of Science's "Composition of Cereal Grains and Forages", and the National Gasohol Commission, respectively.

A block diagram attributable to the Solar Energy Research Institute is also attached depicting the movement of feedstock from the beginning through to the end of the fermentation and distilling processes.

UNITED STATES GOVERNMENT
Memorandum

U. S. DEPARTMENT OF AGRICULTURE
Agricultural Stabilization and Conservation Service

TO : Bob Hamel, CED
Lake County ASCS Office

Date: February 1, 1979
In Reply Refer to: JRF

RECEIVED

FROM : Acting Executive Director
Montana State ASCS Office

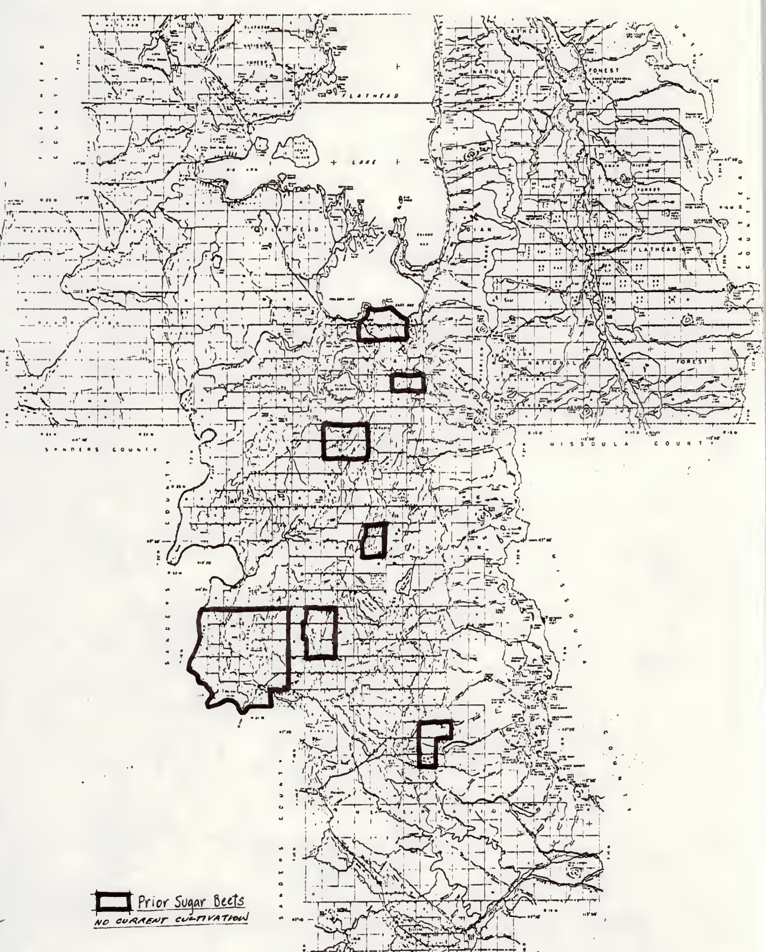
James C Eggen

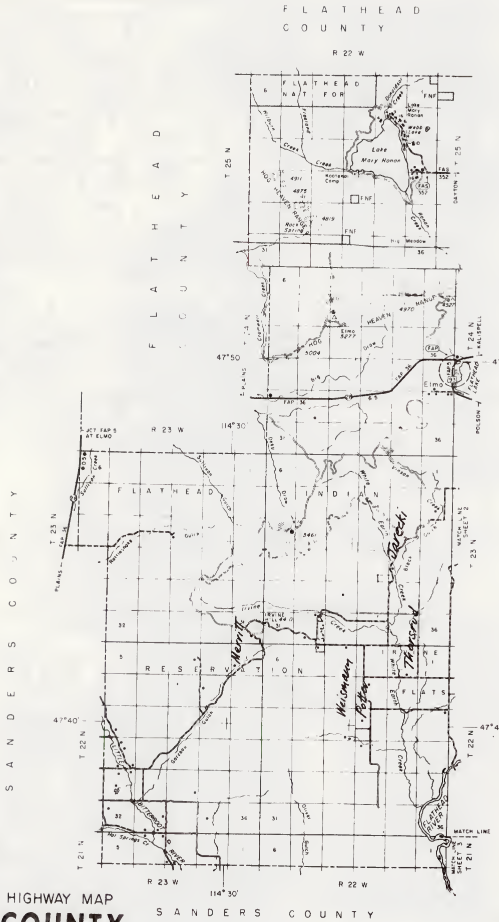
SUBJECT : Advice of Allocation -
Russet Potato Diversion Program

Confirming our telephone notification, an allocation based on producer's request through January 31, 1979 is approved as follows:

	Cwt.	Dollars
Previous Allocation	56,000	$112,000
Allocation Per This Notice	1,000	2,000
Total County Allocation	57,000	$114,000

Please notify this office immediately if any signed releases are obtained from any producers covered by this allocation.

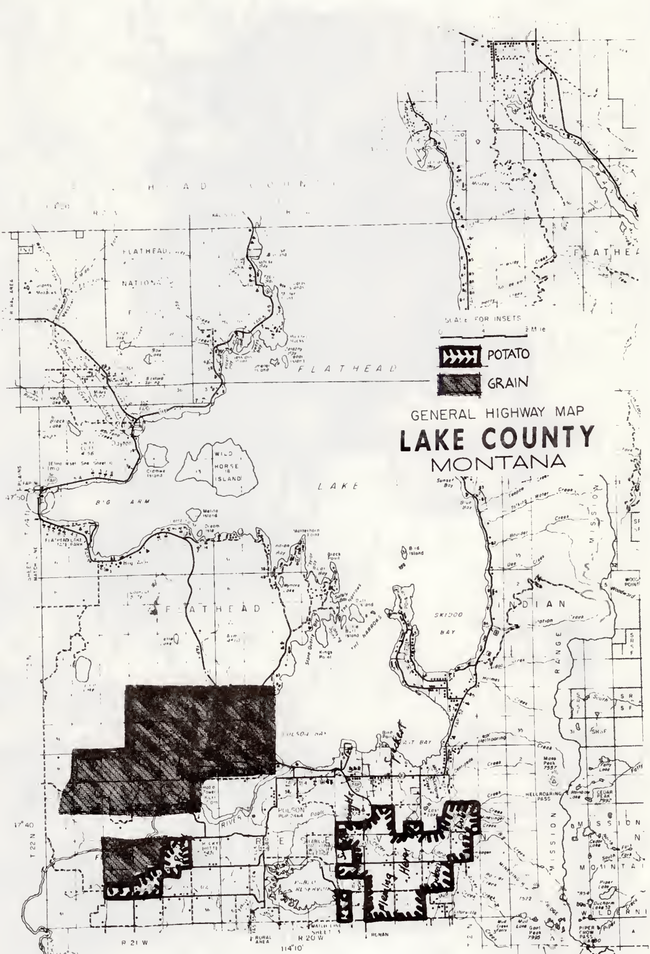

FLATHEAD
LAKE
FLATHEAD
INDIAN
NATIONAL
FOREST
NATIONAL
FOREST
FLATHEAD
SANDERS COUNTY
MISSOULA COUNTY
FLATHEAD COUNTY
SANDERS COUNTY
MISSOULA COUNTY
SANDERS COUNTY
MISSOULA COUNTY
Prior Sugar Beets
NO CURRENT CULTIVATION



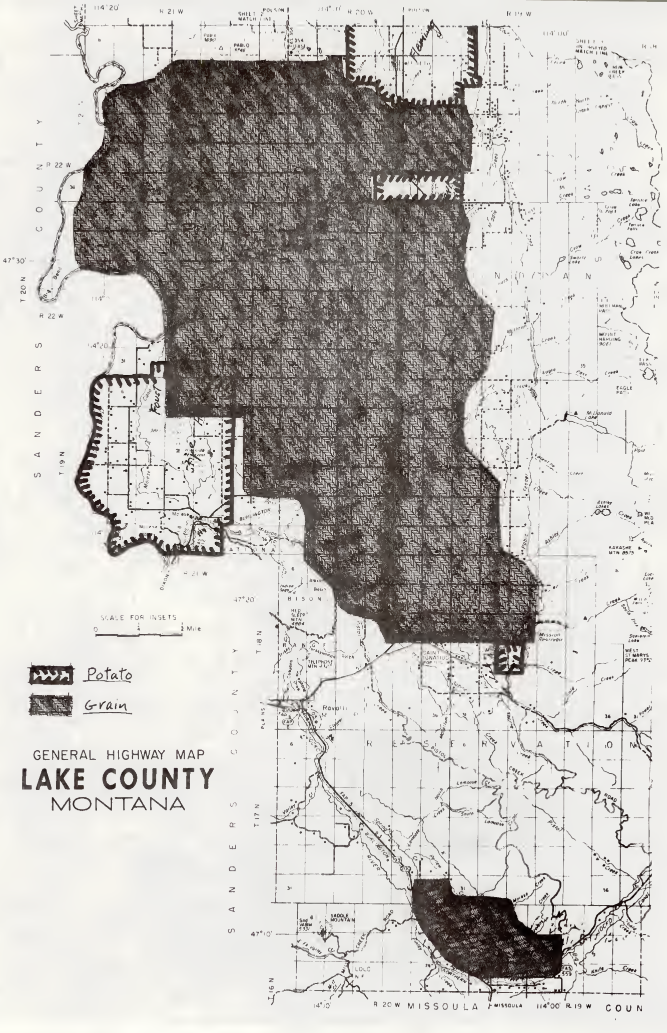
GENERAL HIGHWAY MAP

LAKE COUNTY

MONTANA



SCALE FOR INSETS
0
4
2 Mile
POTATO
GRAIN
GENERAL HIGHWAY MAP
LAKE COUNTY
MONTANA
FLATHEAD NATIONAL F
FLATHEAD
LAKE
WILD HORSE ISLAND
BIG ARM
Cromwell Island
Melita Island
Dream Isle
FLATHEAD LAKE STATE PARK
Big Arm
Elmo
Dayton
FLATHEAD
SKIDOO BAY
Sunset Bay
Blue Bay
Bird Island
Black Point
The Narrows
Kings Point
Matterhorn Point
Finley Point
Polson Bay
Salt Bay
Teepee Creek
Talking Water Creek
Boulder Creek
Hellroaring Creek
HELLROARING PASS
McDonald Peak
CEDAR PEAK
INDIAN
MISSION RANGE
MISSION MOUNTAINS WILDERNESS
Piper Lake
PIPER CROW PASS
Mud Lake
Goat Peak 7995
Mud Creek Falls
POLSON
River
PABLO NATIONAL WILDLIFE REFUGE
PABLO RESERVOIR
RONAN
Mission Creek
Fleming
Hern
Gilbert
Fairy Lake
Woodward
R 21 W
R 20 W
R 19 W
T 22 N
47°50'
47°40'
114°20'
114°10'
114°00'
UNSURVEYED MATCH LINE
SHEET MATCH LINE
RURAL AREA

Potato
Grain
GENERAL HIGHWAY MAP
LAKE COUNTY
MONTANA
SCALE FOR INSETS
0
¼
½ Mile
SANDERS COUNTY
MISSOULA COUN
R 22 W
R 21 W
R 20 W
R 19 W
T 20 N
T 19 N
T 18 N
T 17 N
T 16 N
47°30'
47°20'
47°10'
114°20'
114°10'
114°00'
Fleming
Foust
Shine
Pablo
Polson
Moiese
Dixon
Ravalli
Saint Ignatius
Mission Reservoir
McDonald Lake
Ashley Lakes
RED SLEEP MTN
TELEPHONE MTN
SADDLE MOUNTAIN
MOUNT HARDING
EAGLE PASS
KAKASHE MTN
WEST ST MARYS PEAK
RESERVATION
FLATHEAD INDIAN
BISON RANGE
Jocko River
Pistol Creek
Mission Creek
Crow Creek
Post Creek
Lemoose Creek
Valley Creek
Finley Creek
Big Bend
Burlington Northern
LOLO N F

C. E·H·S·S Factors

C.1 Areas for Potentially Hazardous Environmental Effects

There are three areas to be examined in a basic consideration of potentially hazardous environmental effects -- the EtOH production process, the use of EtOH as a fuel in field equipment on farms, and the unique considerations of both Lake County and the Flathead Indian Reservation both of which are essentially the same geographically.

C.2 EtOH Production

There are several types of impacts on the environment as a result of the production of fermentation EtOH all of which can be avoided by proper precautions. These impacts relate to both a small stilling unit now being used by AfuelsCORP and a larger, over 100,000 gal. unit being proposed. The solutions also apply.

Crop Residue Removal

Possibly the most important potential impact could be the removal of crop residues as a boiler fuel. Crop residues are important because they help control soil erosion through their cover and as a coverage help the ground capture and use or not let go of nutrients, minerals and fibrous materials which help maintain soil quality. Two remedies exist for this potential problem. One is to utilize a chipping unit in a nearby thinning block where a forest is being thinned and use the resulting "hog fuel", thereby minimizing the use of crop residues by a certain percentage goal. Or, keeping to a certain percentage of take-off in that not more than a maximum of one-half of the residues from a grain crop devoted to the EtOH are used to fuel the process. Additional remedies include crop rotation and winter cover crops, typical of this area, to lessen the impact of whatever crop residue removal takes place.

Use of Wet Stillage

Another possible impact is related to the runoff of thin stillage on the open land (see the section dealing with coproducts, under B.6, "Coproduct Yields"). Thin stillage is composed of minute solids and solubles and has a consistency like muddy water. It is a product of a filtering process whereby the coarse materials are filtered out of the primary outtake from the beer and rectifying columns. Two kinds of problems emerge from running off this effluent onto the open land, regardless of the amounts involved or the amounts of ground involved: odor and acidity. Our method of dealing with this problem is to use a sludge plow and controlled spreading. Future plans call for the use of anaerobic digestion to integrate a complete botanical process into the handling of this effluent waste. As to amounts involved, out of a 300-gal slurry, roughly 175-200 gals are left over which are in this catagory. The other parts are turned out in the form of evaporatives and EtOH.

Air Pollution

Two forms of potential air pollution could result from development of an EtOH production facility on a farm or series of farms. First is the release of pollutants from the boiler chimney (the boiler in the proposed facility would be used to produce steam heat and use wood waste and crop residue waste in a controlled burn as fuels). The second is the marginal evaporation of EtOH lost during the production process. If crop residues and wood wastes are used (as is proposed) in a boiler, the resulting pollutants are primarily particulate matter which can be controlled through the use of flue stack scrubbers. The Midwest Research Institute has made a depth analysis of evaporation of EtOH during the process and has concluded that it doesn't pose a major concern at this time. It is mentioned because of its presence as a usual but not major problem. AfuelsCORP used wood waste from a nearby beehive milling wood-working plant in dampered and thermostatically controlled fire boxes manufactured by the same company that makes "Earth Stoves". The boiler system we will integrate into our proposed plant will be an 18-HP low pressure steam boiler and will be purchased and modified with the recommendations of CCI Industries taken into account respecting emissions and pollution control.

C.3 Use of EtOH as a farm equipment fuel

The Clean Air Act of 1977 automatically bans all fuel additives unless the manufacturer can demonstrate that the additive or, in this case, alternate fuel will not cause or contribute to the failure of any vehicle to meet applicable emission standards. The federally specified reference fuel is indolene and the required tests are for emissions of exhaust pipe hydrocarbons, carbon monoxide, nitrogen oxides and evaporative hydrocarbons. These standards apply more specifically to highway passenger vehicles running on gasoline or gasoline-blend fuels while our focus is on field equipment used on farms, many of which are fueled by diesel.

The test for evaporative hydrocarbons involves measuring fuel vapors from the gas tank when the engine is left to idle and at locations such as a pump filling station. The requirements in this and other tests are quite stringent and have resulted in industrywide standard compliance, in automotive fuel tank and motor design, in pumping station equipment design, and refinery controls. The stringency of the standards are illustrated by B. R. Jackson in his testimony before the Environmental Protection Agency on December 6, 1978, when he brought forth the results of an EPA study in which commonly accepted pure summer-grade gasoline failed in testing when measured with the reference standard indolene, failing all four tests mentioned heretofore, and failing in oxidation catalyst and three-way catalyst vehicles.

Alternately, the same study reported that a 90%-indolene/10% EtOH blend showed definate improvements over straight indolene in exhaust hydrocarbon and carbon monoxide emissions, nitrogen oxide emissions equal to summer-grade gasoline, and a slight increase of evaporative emissions relative to, compared with summer-grade gasoline.

EPA and DOE cooperative gasohol testing programs have obtained critical evaluative data with respect to gasohol blends and on the basis of these tests, which are continuing, EPA concludes that:

- gasohol blends decrease hydrocarbon emissions
- gasohol blends significantly decrease carbon monoxide emissions
- gasohol blends slightly increase nitrogen oxides emissions
- gasohol blends significantly increase evaporative hydrocarbon emissions

One December 16, 1978, EPA approved use of gasohol under Section 21(f)(3) of the Clean Air Act of 1977 and found no significant environmental risk with respect to gasohol's continued and escalated use. Before the plenary session of the 3rd Internation Symposium on Alcohol Fuels Technology in 1979, J. R. Allsup and P. B. Eccleston reported the results of their research to the effect that new emissions control systems, such as the 3-way catalyst with carburation feedback, have been found to be equally effective with either gasoline or gasohol.

The Office of Technology Assessment of the Congress continues to gather data on the use of both gasohol and alcohol fuels. It has observed that "...the mixture of observed emissions reductions and increases, and the lack of extensive and controlled emissions testing, does not justify a strong value judgment about the environmental effects of gasohol used in the general automobile population (although the majority of analysts have concluded that the net effect is unlikely to be significant)..." relative to increased risk.

Research questions which are not throughly researched to date which are generated by the activities of AfuelsCORP are:

- o What are the reference standards related to and what would the results be of a test measuring straight EtOH (170P-190P) against diesel fuel?
- o What net positive environmental effects would be gained in a rural setting, on a farm, where vehicular traffic and pocketed air pollution is not a problem?
- o How does gasohol, a gasoline and EtOH blend, compare to straight EtOH in tests against the reference standard indolene?

These questions are important questions and need to be researched by the third-parties consisting of government agencies charged with technological assessment of emerging technologies and fuels.

C.4 Health considerations

The process of manufacturing EtOH does not pose a significant health problem to the worker. The usual safeguards with respect to plant safety must be observed and affect the levels of health and safety; they include overpressurization of pressurized containments and pipes and fittings, the possibility of scalding, possibility of contact burns, ignition of EtOH leaks or grain dust, risk in handling acids and bases and suffocation. These health and safety risks will be addressed (and were addressed on the Hern operation) in two ways:

1. "Pop valves" are installed on containments and line pressure-release valves are utilized. A boiler would feature similar technical devices on the containments and feed lines. Adherence to operating procedures according to manufacturer's guides is a measure of safety. Logs of pressure readings are utilized and will continue to be utilized. Baffles are in place around pressure outlets and flanges and welded joints will be used in steam lines in the proposed Eagle still. All possible contact steam lines will be insulated. Explosion-proof electric motors will be used. Smoking is prohibited near the stilling area and only in designated smoking areas. Use of metal grinders, cutting torches, etc. is by established procedures and containments are always emptied, flushed and vented before such work. There are handling precautionary methods for handling bases, acids and enzymes, regarding slow mixing, storage and contact remedies. No containments, with the exception of storage bins, are large enough or designed in such a manner that suffocation would be a hazard.
2. A standing safety committee will meet monthly and use a checklist related to the above concerns briefly outlined.

The EtOH processes will not pose a health threat to nearly residents, farms or communities. Effluents and emissions are controllable by means of the methods previously described and, as such, would be the only miniscule hazards which could be described as health-related liabilities of the process.

Security precautions proposed for the proposed stilling operation include cyclone perimeter fencing which is electrified at the top and posted and use of a private police surveillance service, as well as the customs of locking the facilities and restricting access.

C.5 Socioeconomic Factors

Lake County in Montana is one of the larger counties in Montana and covers an area nearly as large as the states of Rhode Island and Connecticut. There are four major towns including Polson, the county seat, Ronan, St. Ignatius and Arlee, and outlying towns including Ravalli, Paradise, Elmo, Dayton, Charlo Dixon and Swan Lake. Population counts show that the Polson area has the most people, with Ronan following close behind. Population statistics show that Lake County, contiguously roughly the same as the Flathead Indian reservation boundary, is about 7% Native American, mainly members of the confederation of Indian tribes known as the Confederated Salish and Kootenai Tribes of the Flathead Reservation. Essentially two governments in terms of federally recognized "local government units" exist in this area, the government of Lake County and the tribal government of the confederated tribes of the Flathead reservation.

The Confederated tribes operate a highly successful HUD housing authority which has resulted in both jobs for construction workers and better housing for qualified Indian and non-Indian families on both buying and

C.5 cont.

renting bases. The tribes also have had an EDA 501 Planning Office in existence for a number of years and this office has helped carry out a number of successful business-related enterprises resulting in tribal income and the creation of jobs. The tribes also have a successful post-and-pole yard near Dixon which provides year-around employment to several hundred plant employees and independent contractors. Several tribal members are some of the most successful ranchers and farmers in the area, as well as in the forest products industry. Despite these facts, Indian umemployment and underemployment is high, above 10%.

Lake county and the City of Polson and City of Ronan have planning offices which aren't as highly-geared towards economic development but which have increasingly recognized the need and attempted to address the problems of a seasonally downturned economy and underemployment. The City of Polson took a dramatic step in recent years by the creation of an Economic Development Corporation. The creation of this body was at a time when the economy of Polson, as the illustrative example, was depressed due to a closing down of the town's major nearby lumber mill and its supporting contracting industries. This came on the heels of the closure in the early-70s of a major employer, a plywood mill. Despite these facts the population of Polson and Lake county has grown and the county is recognized as a "growth county." A new bank and savings-and-loan established themselves in the county in the 70s, an encouraging sign of good growth. Significant sub-division development and land sales have contributed to the development of the recreation potential of the area which has as its crown jewel Flathead Lake, a major regional recreation spot. Land-use planning has contributed to an orderly progression of these developments.

Unemployment and underemployment continue to be a standing problem.

A goal of this company is to increase employment by the eventual creation of skill-based jobs for a possible eventual 25 persons. A further goal is to assist in providing technical training to as many individuals. Additionally, the socioeconomic impact of our activity must be viewed in terms of the net economic gain to the farmers who contract with us.

The infusion of hundreds of thousands of dollars into the local economy by making use of otherwise and previously discarded crops and residues is literally the creation of money and jobs.

It is a recognized principle of ecology that anything that is done to make something "costs" something. Our point is that allowing crops to go to waste in the manner now accepted is costly. And many times all that is required is the addition of a nonburdensome additional step to infuse money-generating and job-generating cycles to the economic and operational base. This is true in the buying program of ASCS for waste potatoes, as an example. In 1979, ASCS bought about 50,000 HW of potatoes as agricultural feed, at slightly under $100,000 from 5 area farmers. Adding the cycle of distilling EtOH and still using the coproduct for feed would infuse more dollars into this program. (see memorandum of ASCS attached in this section for exact figures of the ASCS livestock feed program). Again, this particular example involves the purchase and use of otherwise wasted crops. The monetary value of these potatoes at $1.00/gal of EtOH would be nearly $50,000.

C.5 cont.

Specific socioeconomic goals include:

GOAL ONE: Identify and integrate into existing programs to utilize crop wastes

GOAL TWO: Utilize and market crop wastes in the form of coproducts as livestock feed, to effectively double the return to farmers

GOAL THREE: Distill and market fuel-grade EtOH fuel which will feature lower prices per gal and hold the line on cost increases for at least 18-month intervals

GOAL FOUR: Provide employment opportunities for at least 25 persons by 1982

GOAL FIVE: Provide employment opportunities for economically disadvantaged, minority and young workers in the local labor pool

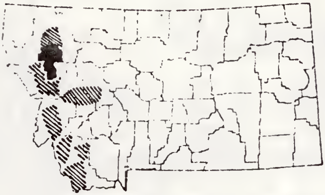
GOAL SIX: Research ways to help local development committees and agencies develop new support contracting and support technologies related to EtOH production

GOAL SEVEN: Analyze the possibility of siting a USDA research laboratory in the lower Flathead valley

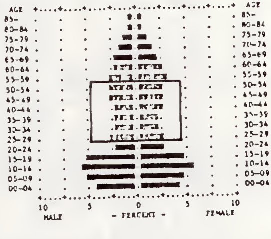
* * *

C.6 Specific Demographic Characteristics of Lake County

The map below depicts Lake county in black compared to the state of Montana and Montana's western agricultural areas which are shaded. According to the 1970 census, Lake county had about 14,000 people. 1970 census data also indicates that roughly 23% of the population was 25 years of age or below while slightly under 10% were age 65 and above (see chart below). The chart entitled "Population by size of Urban Center" indicates that 70% of the county's population live in a rural setting, either in or nearby unincorporated towns or on farms, ranches and outlying subdivisions.



POPULATION BY AGE & SEX
(1970 CENSUS DATA)

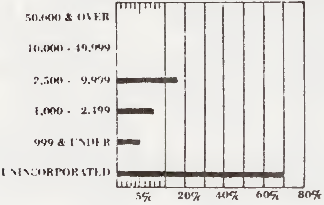


	MALE			FEMALE	
AGE	NUMBER	PERCENT OF TOTAL POP	NUMBER	PERCENT OF TOTAL POP	AGE
85-	74.	.5	82.	.6	85-
80-84	112.	.8	135.	1.0	80-84
75-79	190.	1.3	194.	1.3	75-79
70-74	254.	1.8	256.	1.8	70-74
65-69	319.	2.2	331.	2.3	65-69
60-64	357.	2.5	392.	2.7	60-64
55-59	430.	3.0	475.	3.0	55-59
50-54	380.	2.6	507.	3.7	50-54
45-49	367.	2.5	390.	2.7	45-49
40-44	361.	2.5	372.	2.5	40-44
35-39	358.	2.5	354.	2.5	35-39
30-34	327.	2.3	347.	2.4	30-34
25-29	395.	2.7	371.	2.6	25-29
20-24	361.	2.5	369.	2.6	20-24
15-19	760.	5.3	675.	4.7	15-19
10-14	857.	5.9	800.	5.5	10-14
05-09	775.	5.4	714.	5.0	05-09
00-04	584.	4.0	581.	4.0	00-04
TOTAL	7261.		7,84[illegible].		TOTAL

The blocked-out area above indicates the number of median-age working people of both sexes (of working age). Preliminary 1980 census data indicates that Lake county

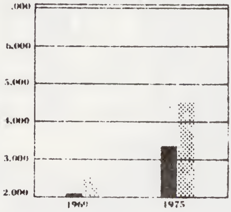
B.6 cont.

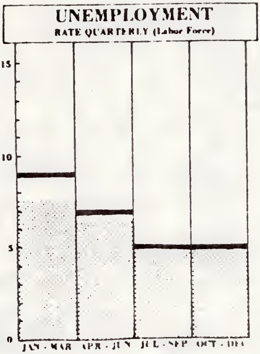
has appreciated a population increase of nearly 20% over 1970 figures.


POPULATION BY SIZE OF URBAN CENTER
(1976 CENSUS REVISED POPULATION ESTIMATES)

Per-capita income for the years 1969 and 1975 compared with the state's mean average depicted in the chart below indicates that in 1969 the per-capita income for Lake county was $2,200 compared to the state mean of $2,550 while during 1975 the county per-capita income was $3,400 compared to the state mean of $4,500. By estimating 1980 per-capita by adding 10% for each year since 1975 the figures come out at $5,476 and $7,248 respectively. A state-commissioned study of poverty in Montana identifies Lake county as a poverty-impacted area.

Unemployment is one large reason why Lake county has a lesser per-capita income when compared to the state mean average. The quarterly rate for unemployment is depicted under the chart "Unemployment" and reflects figures for 1978. Winter is chronically the time of year when unemployment peaks and when jobs are hardest to acquire. The chart reflects a leveling off during summer months. Layoffs in both the agricultural and wood products industries are the main contributors to seasonal

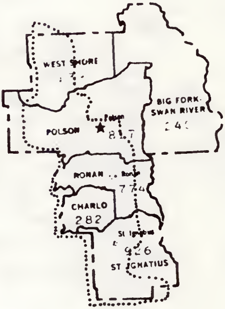

PER CAPITA INCOME
EST 1969 & 1975



unemployment. The chart at left also depicts the state mean average of unemployment during 1978 (in shaded areas). 9% unemployment during the winter months, mostly because wage-earners and heads-of-households are laid off, is the norm. The rate of unemployment among Indians is slightly higher than the averages depicted here.

In terms of identified poverty-level individuals, the map below indicates the numbers of poverty-level individuals regionally distributed throughout the county. There is a concentration of poverty households and poverty-level wage-earners in the lower, southern portion of the county. The area enclosed by the dotted-line indicates the rough boundary of the major farming areas in the county. The map depicts that 3,178 poverty-level wage-earners live in the county.

The data presented here allow a number of conclusions. First, Lake county is an economically underdeveloped area with an agricultural and wood products industrial base. Wage levels have historically been low and depressed. Unemployment has been relatively high even when seasonally-adjusted. There is an available labor force for



expanding, new and emerging industries. A critical factor is that nearly 23% of the population by 1970 census figures are age 25 or under; of this group, nearly 45% are between the ages of 10 and 19. There bespeaks a need for employment opportunities for young people now in school who will soon be entering the labor force. Technical and professional training are career-targeted and job-targeted means young people are increasingly using to get ahead. The complaint is made that few technically-skilled or talented young people return to their home of origin due to the lack of jobs relevant to their training and competencies.

The emergence of industries such as a growth company producing alcohol fuels and the emergence of agronomists and farmers who cultivate feedstock for alcohol fuels production will stand to attract technically-trained and professionally-qualified young people back into the area.

The confederated tribes of the Flathead reservation have made significant strides to upgrade the skills and technical-training of tribal members both at a pre-vocational level and for working members. In the mid-70s they established a community college which offers technical training in several areas of economic and business importance to both the tribes and the overall area economy. Typical of this is their 2-year technical program in forestry. As the needs for technical training curricula have emerged so the curriculum of the college has been formed. It is likely that area colleges and junior colleges and technical schools will form offerings in the technical sciences related to agriculturally-based EtOH production.

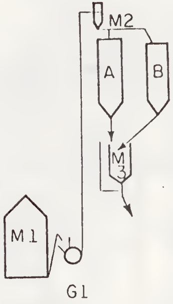
C.6 cont.

LAKE COUNTY ECONOMIC FIGURES

	NUMBER	RANK	% or RATE PER 1,000 COUNTY POP.
POPULATION			
1978 Population	18,300	10*	
Sq. Miles	1,494	46	
Population Density	12.25	7	
LOW INCOME POPULATION			
Poor Persons	3,184		22.3%
Near Poor 125% Poverty	4,483		31.3%
Low Income Elderly	583		29.9%
HEALTH-MEDICAL			
Births	334		18.2*
Crude Deaths	206		11.2*
Infant Deaths	6		17.9*
Doctors, MD	20		
Dentists, DDS / DMD	9		
Total Hospital Beds	95		
PUBLIC ASSISTANCE			
AFDC Recipients			33.4*
Food Stamp Recipients			36.7*
SSI Recipients	230		12.6*
EDUCATION			
High School Drop Outs	64		4.8%
SOCIAL & HEALTH DISORDERS			
Alcohol Admissions by County of Res.	176		9.6*
Developmentally Disabled Served	40		2.19*
Crime Rate	517		28.9*
Divorces (1977)	135		7.7*
HOUSING			
Owner Occupied Housing Units	3,378		
Owner Occupied-Inadequate Housing	567		
Renter Occupied Housing Units	1,034		
Renter Occupied-Inadequate Housing	440		
EMPLOYMENT			
Unemployment Rate			6.3%

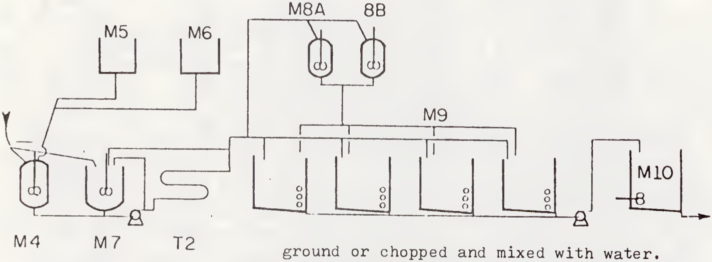
* rank compared to 55 other counties

D.1 Description of Typical EtOH Production w/Schematics



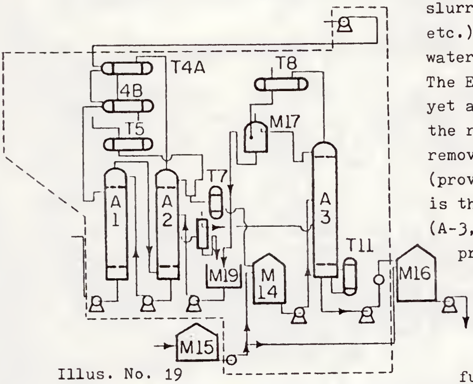
Illus. No. 17

Illustrations Nos. 17 through 20 depict a representative plot plan for a 600-gal/da still with anhydrous capability using available, conventional technology. The schematics were originally prepared by Dr. R. S. Chambers of the ACR Process Corporation in New Jersey. The plot plan is specific to a sweet sorghum operation but adaptable to starch-based and other sugar-based feedstock. The details of the operation will vary to some extent in the erection and ongoing equipment testing and modification phases according to the substrates, the capacity and heating sources integrated and by combining available technology with site-considerations. There are five basic sections. First, the substrate is conveyed from storage (M-1), is ground or chopped and mixed with water. Second, the substrate is cooked and treated with enzymes to convert starch into sugar (M-4 & 7, T-2). If the substrate is already sugar, the second step may be bypassed. Third, yeast is added and the mash slurry ferments. During the fermentation cycle the yeast converts most of

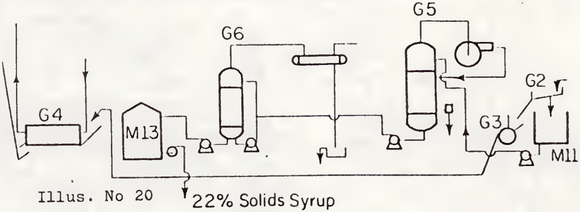


Illus. No. 18

the sugars to EtOH and CO_2. Fourth, the "beer" is fed at a controlled rate through successive distillation columns in which the EtOH is separated from the redisual slurry (fibers, yeasts, etc.) and most of the water (A-1, -2, etc.). The EtOH passes to yet another column where the remaining water is removed by a drying process (provided anhydrous EtOH is the product being made) (A-3, etc.). The resulting produce is denatured according to FED requirements which is suitable for use as a direct farm fuel. Anhydrous EtOH may be set aside for blending with gasoline. In the fifth step, the residual solids are separated from the "thin stillage" (G-3). The thin stillage may be concentrated (G-5, -6, etc.) and the solids may be dried (G-4). Flue-gas from the boiler flue can be captured and moved through insulated conveying pipes to the drum drier. Step 5 does not need to be nearly as sophisticated as the schematic



Illus. No. 19



Illus. No 20

indicates. The whole stillage can be fed directly to livestock and if this route is chosen above processing into dried feeds, it must be consumed on a daily basis in order to avoid spoilage and site storage problems.

D.2 Block-Representation of Ethanol Production

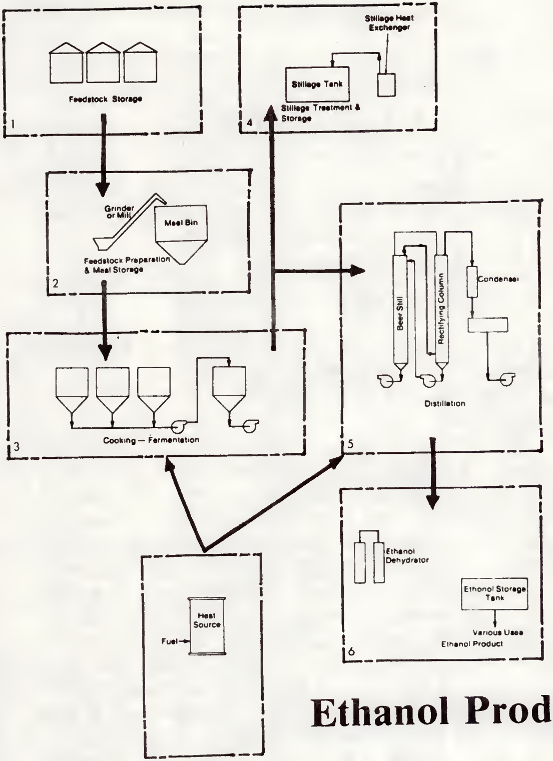
Perhaps a simpler way to overview EtOH production is by means of Illustration No. 14, "Ethanol Production Flow Chart"; there are six sections depicted. The process is as follows:

1. Feedstock is acquired and stored
2. Feedstock is elevated to Hammer Mill and Pre-conditioning Process
3. Slurry is fermented
4. EtOH-bearing liquids are separated from the stilling; stillage is set aside and slurry drawn off is conveyed to still
5. Slurry draw-off is distilled to between 160P and 190P EtOH
6. The option of further drying is used to produce solvent- and anhydrous-EtOH; EtOH is stored

D.3 Description of Still Used in Present Study

The components of our present 100-120/gal day still and some of their features are as follows:

- Fermentation tanks are 660-gal fuel tanks
- Fire boxes are thermo-controlled "Earth Stoves" custom-built by the Polson Stove Shop
- Valves are 2-inch gate valves
- Pipe is 2-inch black iron
- Hammer Mill is hung on 300-gal modified fuel tank
- Pump is 260-gal per minute "Pacer" pump
- Still is a 300-gal capacity w/ 5/gal per hr



Ethanol Production

Lake County Resource Recycling Company

"America's Products for Energy"

Illustration No. 14

rated capacity of EtOH output

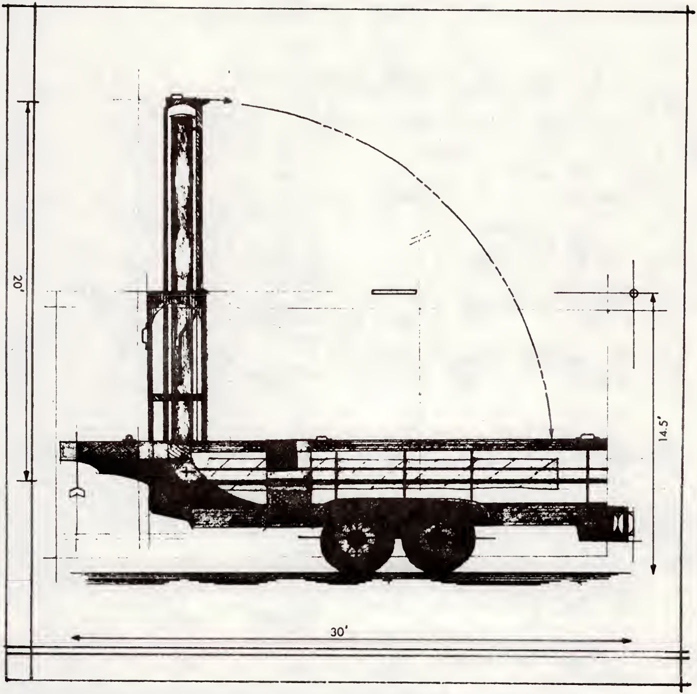
- Column is 48" glass-packed and the condenser is made of copper and copper-tube inner-coiled and hung on side of column
- Reostats with quick-climb reading capability are on fermentation tanks, on the still boiler containment and at the top of the column
- Still was fitted with pressure "pop-valve"
- a pair of smaller stills were also constructed and utilized for demonstration purposes

Heat was generated for this stilling operation in fire boxes welded onto the fermentation tanks and the bottoms of the still slurry containments. Wood wastes were the only sources of heat utilized.

D.4 Description of "Eagle Still" Proposed

One of the outcomes of the study conducted for feasibility purposes was to design a 600-800/gal day still which could be used at a fixed site and which would also feature portability.

We propose to further modify the Hern operation to site a permament stilling operation on that farm. But we also plan to be able to mount the distilling components on a fifth-wheel trailer. Then we could both take care of feedstock delivered to us at Hern's as well as deliver "jobber" fuel orders by tanker truck and also deal with the farmer or farmer co-op that selects the route of installing feedstock handling and fermentation tanks and has us come to the farm site and distill the fermented, ready mash. A rendering of the "Eagle Still" is enclosed as Illustration No. 15. Further more specific blueprints are being readied by David M. Mauthe, P.E. of High Valley Engineering in Polson (successor to Golden



EAGLE STILL Trade Mark ◦ **EtOH·fuels·corp** U.S.A.

Illustration No. 15

AfuelsCORP and EAGLE STILLING UNIT

Equipping List

Component	Number	Specifications
Honeywell Master Control Unit w/ switches & guages	1 ea	Master Control, LEDs for temp readouts
16-foot stripping column	1 ea	stainless, with internal packings
16-foot Rectifier column	1 ea	stainless, with internal packings
Condenser Tank	1 ea	steel, copper tube lined
Boiler Water Preconditioning Tank	1 ea	steel, copper tube lined
Mash Gear Pumps	3 ea	variable speed, electrical, w/ Master Control shutoff
Reflux Pumps	2 ea	one speed, w/ Master shutoff
Boiler Hot Water Demand Pump	1 ea	one speed, w/ Master shutoff
Overhead Sprinker system (fire control)	1 ea	Master Control Actuated, w/ Remote Tripping Control
Various Thermal Couples, Valves and Gauges	numerous	
Fermentation Tanks	6 ea	Thermostatically controlled, Master Control monitored and tripped, w/ propellor agitators
Mash Separator	1 ea	
18-HP low pressure steam generating boiler, conventional fluidized bed	1 ea	

D.4 cont.

Engineering, our original engineering firm which was sold to Mauthe).

The "Eagle Still" will feature stainless steel columns and stainless steel internals to insure longer equipment life and increase hourly-production.

The "Eagle" will feature Honeywell controls consisting of temperature and pressure and line-flow LEDs and indicators. Automation will be integrated.

The equipping list is contained elsewhere under this Section and lists the 13 major components and component assemblies.

D.5 Basic Recipe Used in Study

The basic recipe we used and arrived at is:

1. Fill the cooker halfway with water
2. Start fire
3. Agitate
4. Slowly add bushels of ground grain (4 bu)
5. Test pH - must be adjusted to 7; if pH is below 7, add caustic (Dolomite lime); if pH is above 7, add acid (battery)
6. Add 1 oz. of Takatherm
7. Heat until temp is 200°
8. Add 2 oz. of Takatherm
9. Hold temp between 200°-212F for 30-minutes
10. Cool to 185° by adding water
11. Add another 2 oz. of Takatherm
12. Hold at 185 for 15 minutes.
13. Complete sugar test (use glucose dip sticks)
14. If sugar is not indicated, keep the temperature at 185 for about 20 minutes and retest. If the sugar does not then come out, add another oz. of Takatherm and hold at 185 for 15 more minutes. Then retest.
15. Cool to 140 by adding cool water and reach top of cooker. In any event, let cool to 140 .
16. At 140 , add 4 oz. of Diazyme

17. Let cool to 100 (natural cooling could take 24 hours). Then add yeast. Add yeast in mixed, dilluted form. Be sure temp does not rise beyond 100 or yeast-kill will result. With water at 100 add 8 oz. of yeast (dry or cake) and 4 oz. of Amonium nitrate (acquire at any fertilizer elevator). Cover and shake yeast mixture well and let sit in warm place for 15 minutes. Check slurry holding tanks and if temp is 100 and below add yeast and stir in well by agitation.
18. Have covering over vat so that heat does not escape but gases do (or are impounded).
19. Agitate once but then do not agitate any more. Let mixture stand 48-60 hours until a slurry "crust" has formed on top. This crust should drop to bottom of tank. Now mixture is ready to separate.
19. Separate mash from beer water.
20. Outtake and run into still. Maintain heat at top of column at 175 as EtOH vaporizes at 173 F.

Enzymes used are stored prior to use in heavy-duty containments supplied by the manufacturer/supplier. Our enzymes were purchased from Miles Laboratories in Elkhart, Indiana. Enzymes are in good supply as respects future production and the necessary supply of hydrolysis enzymes.

D.6 Enzymatic Hydrolysis of Starch Crops

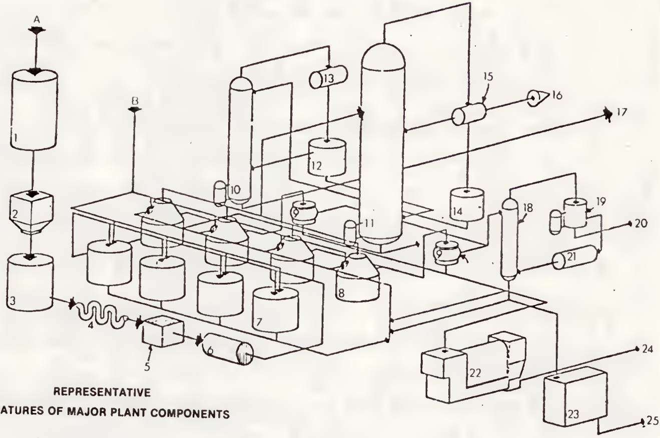
The technical details of enzymatic hydrolysis are contained in the Appendices, Exhibit G.

D.7 Features of a Plant Integrating Enzymatic Hydrolysis

Illustration No. 16 depicts a plant which would produce 160P-190P EtOH along with optional EtOH drying. This side view of a plant layout depicts line flows and slurry and coproduct conveyances and impounding processes.

Enzymatic Hydrolysis

PLANT DESIGN



REPRESENTATIVE
FEATURES OF MAJOR PLANT COMPONENTS

A	Feedstock
B	Saccharomyces
1	Feedstock Store
2	Grinder/Mill
3	Slurry Tank
4	Heating/Con Tank
5	Bypass Tank
6	Bypass Tank
7	Hydrolysis Tanks (1 plus Add-ons)
8	Fermentation Tanks
9	Tank for yeasts
10	Beer still
11	Rectifying Still
12	Precon Tank
13	Condenser
14	Bypass Tank
15	Water Runoff & Recirculation
16	CO_2 Impounding
17	190P EtOH Store
18	Drying Column
19	Solvent Process
20	Solvent EtOH
21	Bypass Tank
22	Drum Dryer
23	Final Separator
24	Distillers & Feed Grains
25	Process Tailings

**Lake County
Resource Recycling
Company**

P.O. Box 679 • Polson, MT 59860 • (406) 883-5695

Illustration No. 16

D.8: Cost Breakdowns of Stills

With respect to the still used in this study, about $2,400 was expended to purchase materials. All of the work including electrical and plumbing engineering and set-up were contributed by members of the company, with Rick Van Voast supervising. In terms of time-valued labor, the company contribution amounted to nearly $8,000.

The "Eagle Still" would feature parts made by CCI Industries in Illinois (e.g., the 16' beer and rectifying columns, etc.) and the set-up labor involved, including making necessary site- and building-modifications, would be provided by company personnel skilled in these areas.

Ongoing advice and professional evaluations have been and will continue to be provided by High Valley Engineering situated in Polson. Ongoing advice and site-inspection are provided by Malone Irrigation as to plumbling and feed-line specifications and set-up. Set-up and operation of the 18-HP low pressure steam boiler and transmission piping will be set up according to specifications of CCI Industries. The fire marshall for Lake county will be involved at all critical and evaluative stages of plant set-up and equipment testing and modification. Appropriate permits are to be obtained.

D.9: Overview of Budget:

The budget for operation of the "Eagle Still" for PY81-82 is itemized on pages 60-62. The budget catagories are:

- Materiel
- Process-Related Expenses
- Staffing/Personnel Expenses
- Office/Business Expenses

Materiel includes all equipment and support-equipment related to dist-llation, site-improvements and modifications, building-improvements and modifications and coproduct handling equipment. Process-related expenses include enzymes and equipping a site-laboratory. Staffing-Personnel expenses include half-year salaries for three full-time individuals and a number of shifting part-time personnel. Fringes and maintenance costs are also factored into the figures. Office-Business expenses cover costs created by insurance coverage needs, office functions, etc.

Cost-sharing is provided in part by the value of buildings assigned over and dedicated to our use. Considerable cost-sharing has been provided by AfuelsCORP.

The operational expenses are the subject of further grant-seeking efforts from the FED and the state on the part of AfuelsCORP.

OPERATIONAL BUDGET

Agrifuels "Eagle" Still

Catagory/Item	Local Cost-Sharing	Amount Requested
I. Materiel		
A. 600-800 US gal/da Eagle Still - Honeywell Master Control Unit - 16-foot stripping column - 16-foot rectifying column - condenser tank - boiler water precon tank - mash gear pumps - reflux pumps - boiler hot water demand pump - overhead sprinkler system - thermal couples, valves, gauges - fermentation tanks - mash separator - 18-HP low press conventional fluidized-bed boiler	--	$45,000
B. 6 Fermentation Tanks	800	20,000
C. Electrical mods	--	5,000
D. Plumbing mods	--	5,000
E. Installation and Set-up Labor $10/hr x 1,100 hrs	9,000	2,000
F. Site & 2 Buildings	70,000	--
G. Concrete slabs & footings	2,000	2,000

H. Interior spaces	1,500	1,500
I. Mash handling equipment	--	20,000
I. Sub-totals:	$90,500	$100,500
II. Process Related Expenses		
A. Enzymes, chemicals	--	8,000
B. Lab equipment	1,500	2,500
II. Sub-totals:	$1,500	$10,500
III. Staffing/Personnel Expenses		
A. 10,000 hrs. x $6/hr.	60,000	--
B. 10,000 hrs. x $6/hr.	--	60,000
C. Fringe Benefits (FICA, workmens' comp. et al.)	1,500	1,500
D. Maintenance of Equipment (5% of operational staff costs)	3,000	3,000
III. Sub-totals:	$64,500	$64,500
IV. Office/Business		
A. Insurance	--	4,000
B. Utilities/services		
- Electric (15 AMP/hr. x .16¢/hr)	--	960
- Water	--	600
- Sanitary	--	600
- Fuels (wood waste handling expenses calculated same as solar gas (68¢/US gal x 120 gal/da))	--	4,368

C.	Mileage (300/mi x 12 mos. x .18.5¢/mi)	--	7,992
D.	Telephone	--	1,800
E.	Postage/mail/freight	1,500	750
F.	Advertising	6,000	1,000
G.	Company vehicle exps, fuel, etc.	10,000	3,000
H.	5th-Wheel Trailers	2,000	6,000
IV.	Sub-totals:	$19,500	$31,070
GRAND TOTALS: (Parts I-IV cummulative)		$177,500	$204,570

Local Cost-Sharing $177,500

Amount Requested in Cost-Sharing $204,570

E.1 Concluding statements of work

Agrifuels Corporation (AfuelsCORP) and Lake County Resource Recycling Company (LCRRC) were formed in March, 1980. Since that time a dedicated effort has resulted in erecting an operable still, distilling a variety of feedstock, preliminaries in the formation of a viable business plan and public demonstrations of the still's operation before hundreds at open houses. Our assessment of the needs of a single farm is complete and the decision we have made is to proceed to develop a farm-sited distillery on the Leonard and Hilton Hern ranch, the still to be of a more sophisticated nature than our experimental still.

The following work outlines are in the order of (1) the work scope and tasks completed or underway; and (2) work that is planned as a logical consequence and outcome of our work to date.

These scopes of work and the progress so far must be carried further. The tasks would be substantially furthered through grant assistance from the agencies of Montana government charged with oversight of alternate fuel and energy grant programs.

The corporation has moved rapidly. But we are also moving with caution, deliberation and prudence. Subsequent phases of our project will be accomplished with the same dispatch and care, and with improvements, as befits the task at hand: participating in liberating America's and Montana's farmers from the energy bind of exorbitant and unreasonable fuel costs. It is expected that we will be requesting additional support of several hundred thousands.

E.2 Scope of Work Completed:

A. Design in detail, erect and mechanically integrate an experimental still capable of stilling 100 gal/da of 150P to 180P EtOH

- using local jobbers as suppliers
- using the technical skills of firm members
- identifying equipment as to specification
- locate and convert facility and fixtures
- test differing production volumes
- successfully negotiate contractor and supplier provided costs
- institute reviews and recordkeeping

B. Secure sources of process inputs

- for grains, barley and wheat
- for wood wastes and baled straw
- for utilities including electric and water
- develop business contracts and checklists

C. Acquire necessary licensing and permits as required by local, state and federal agencies

- for plant process
- regarding site, meeting fire code and safety codes, both in compliance and by voluntary measures
- for EtOH production

D. Prepare plans and procedures

- related to site alterations and preparation
- related to physical plant configuration
- related to critical path handling and management
- related to staffing
- related to logistics and time-valuing
- related to safety
- related to materiel procurement

E. Prepare and carry out a project management and scheduling plan

- related to plant design period in first phase
- related to contract periods
- related to still construction
- related to startup of stilling operation

E.2 cont.

F. Arrive at the economic feasibility towards further development of a 600-1,000 gal/da still

- for project capital costs
- for operating costs
- for project operating income
- for investment structure
- for investment risk analysis
- for government investment credits, production credits, capital improvement credits for the landowner, other incentives
- identify Montana and Fed grant programs applicable towards larger stilling capability

G. Prepare an environmental report (Section 4: EHSS Factors (Environmental, Health, Safety and Socioeconomic) meeting national, Montana and local and tribal* stipulations

- for answering NEPA and MEPA criteria relative to what type of report is necessary
- to include a basic report in the feasibility study
- for analysis of monitoring and control measures at the physical plant and the surrounding area as required now and in the future
- for management and technical actions to deal with all environmental issues including regulatory compliance and local and tribal concerns
- to establish a permanent safety consisting of workers and management and board members
- to address health and socioeconomic factors related to both the production of EtOH in the present and proposed facilities as well as the health and socioeconomic factors related to consumer use of EtOH as a vehicle fuel
- identify areas of concern related to occupational and public safety
- establish emergency procedures
- eliminate hazards by a checks and remedies system
- establish effective mechanical and electronic control systems
- establish fire control systems and conduct a physical plant tour with the fire marshall

H. Construct the plant and install all process facilities and equipment

- for testing
- for phased, integrated startup testing
- towards the goal of full or simulated full operation

---

* the plant is situated on the Flathead Indian Reservation, nearly geographically contiguously the same as Lake County

Related to Scope of Work Completed, by section:

A. We designed and erected the still which is described in detail in Section 4: Plant Technology. Some may choose to call the stilling operation "primitive"; however, a more accurate description would be that it is basic as a beginning step, for an emerging company, in an expanding and ever more-refined technology. Local jobbers were used as suppliers including Malone Irrigation, Davis Hardware, the Big Sky Fabricators (Stove Shop), Marshall Bjork Exxon Bulk Dealer, et al. Specifications of equipment are examined and detailed in Section 4: Plant Technology.

B. Sources for process inputs now include the Hern Farm (potatoes and forage), the Van Voast Ranch (wheat and barley). Wood wastes come from and are in good supply from Western Bee Plant, a beehive plant which discards large volumes of millend pine waste. Utilities were paid for by the company, fed through a metered inlet at the Hern Farm. A checklist was developed by Stacy Young and Rick Van Voast, included in the section dealing with the Marketing and Business Plan.

C. A Fed ATF permit was acquired in time to engage in production. We voluntarily came into compliance with fire and safety codes.

D. We altered and prepared the site and developed a plant configuration which we changed from time to time. We mounted the hammer mill on skids so we could move it at will. We set up schedules to stand watches while the mash was being fermented (during critical and peak temperature periods) and while mash was being distilled. We established a notification procedure in the event of a problem.

E. We carried out a management plan related to site preparation and plant construction based on weekly goals.

F. We arrived at the decision to secure and erect an Eagle Still manufactured in part by CCI Industries for the future. Our capitalizing costs have been determined to be nearabouts 300,000 dollars for the 18 months following January 1, 1981. This is further developed and discussed in the

E.2 cont.

section dealing with market analysis and the business plan.

G. An environmental report is included in this report as a separate section and addresses EHSS factors.

H. The plant was successfully constructed and tested. Test runs of area feedstock were made, with varying results. Experimental logs and summaries are contained in the section dealing with Plant Technology. The highlight so far has been an open house attended by nearly 200 persons, featuring Lt. Gov. Ted Schwinden as the guest speaker as well as officials from the departments of Agriculture and Natural Resources and Conservation.

E.3 Work that remains and is planned:

A. With the assistance of a consultant, develop a viable Business Plan

- plan to be used with potential investors and capital sources and in grants
- plan to finally develop the coherent negotiation and contract steps related to cooperative agreements

B. Design in detail, along with cost estimates, an integrated 158K to 264K gallon capacity EtOH production process

- utilizing the Eagle Still
- installing all related facilities and fixtures
- setup adequate for simulated tests of input and output volumes
- adequate for raw produce and contract agreements
- with periodic review during construction and fitting out and testing

C. Design in basic detail a floorplan of the plant layout and outside facilities for storage of feedstock and finished produce (EtOH)

- set up augering between existing grain bins and the plant
- create a floor plan
- develop electrical and plumbing floor plans
- integrate facility to equipment as per spec with the assistance of a retained engineer
- with usual periodic reviews

E.3 cont.

D. Secure additional inputs of feedstock as production warrants

E. Secure market outlets for various proof EtOH

  - through government EtOH buying programs
  - through local exchange and selling
  - by selling anhydrous EtOH to batching plants
  - for carbon dioxide
  - set up processing mill to make feeds from mash residues

F. Acquire necessary licensing and permits

  - for plant processes, including boiler operation
  - for plant siting and construction
  - for business operations
  - regarding environmental protection respecting possible effluents or emissions
  - for easements and rights-of-way
  - for rental, purchase or leasing of land and buildings
  - for EtOH production, storage and sale

G. Prepare detailed plant and process operational manual and procedures handbook

  - for plant alterations and preparation
  - for physical plant configuration
  - for facility management, groundskeeping and maintenance
  - to enact and carry out equipment modifications
  - for critical path handling
  - setting up staffing and personnel procedures
  - setting up logistical measures
  - establishing safety regulations and carrying forward the work of an existing safety committee
  - to procure materiel as needed
  - to establish stock control and requisitioning procedures
  - to establish banking procedures, as needed

H. Prepare and carry out a project management and scheduling plan

  - for the plant design period and staff training with the equipment contractor
  - for the bid and contract period
  - for the plant construction period
  - for plant startup

I. Refine and update the feasibility economic analysis

E.3 cont.

- for emerging project capital costs, establish a cost control and cost overrun prevention analysis
- to ascertain emerging operational costs
- to assess sources of revenue and production on a quarterly basis
- to engage in a continous search for project financing
- to engage in risk evaluation
- to engage in sensitivity analysis
- to engage in continuing applications for government grant-in-aid and cost-sharing agreements

J. Prepare a more exhaustive EIS as needed

- meet specific tribal regulations concerning clean air and streams
- conduct our own scientific tests of EtOH as a vehicle fuel, with an emphasis in diesel fuel substitution

K. Continue to be in compliance with all areas of safety and public health concerns

Related to work that is planned, by section:

A. A business plan that is thoroughly researched is vitally necessary. Several potential CPAs have been identified as possible sub-contractors.

B. The Eagle Still is described in detail in a sub-section entitled "D.4 Proposed Stilling Operation for 1981", under the section dealing with Plant Technology.

C. A basic floorplan is proposed and set forth under the section dealing with plant technology.

D. Additional sources of feedstock are readily available resulting from our discussions with area growers A more formal procedure is being developed.

E. Market outlets need to be developed. It is proposed generally, however, that local area growers and farmers be given the opportunity to run their farm equipment on straight EtOH fuels.

F. Commercial sale licensing is needed. Also a state business license will be needed as well as licenses related to vehicles carrying volatile fuels.

G. A company policy and procedures manual will be developed containing the full range of operational and personnel procedures. Stock control and requisitioning procedures need also to be set up.

H. A project management and scheduling plan related specifically to the construction and on-line testing periods will have to be developed in detail.

I. Continuing research and supervision will be required in order to exist within the economic boundaries imposed by the costs of the plant and operations and the anticipated revenues. Grants-in-aid from the government will be expected to be a continuing source of support; however, as company revenues and income increase, some of these initials supports will fade and may be repaid.

J. The company has a keen interest in the environmental integrity of the lower and upper Flathead valley and will adhere above and beyond basic environmental requirements.

K. Safety and public health concerns will be the subject of concern of a permanent worker/management team which will identify problem areas and seek means of change and compliance.

SUMMARY:

The project has involved a great deal of dedicated work to date. It is apparent, however, that this beginning is only a foothold in terms of future development. It is the intent on this brief overview to give observers an idea of the work that is open before AfuelsCORP and to encourage their participation.

E.4 Projected Income and Expenses of 600/gal. Still

The Eagle Still, while designed to produce nearly 900 US gal/EtOH per day, is analyzed on an Income and Expense Ledger at a conservative 600 gal/da.

The still used on the Hern farm for the experimental phase running from May through September, 1980, was not designed for commercial production and there were neither goods bought or sold with respect to either feedstock or EtOH produced.

The section "Revenues" following depicts the price of EtOH we are aiming at ($1,00/gal.) and speaks to using both waste potatoes and barley. The WPTA 40¢/gal. tax credit is also included as income since the income feature is high enough to offset a corporate tax liability. Revenues from the sale of coproduct feeds made of potato and barley dried mash are depicted. Barley would be sold for the net cost before fermentation based on bushel units.

The section "Cost of Goods Sold" depicts the cost to us to purchase the feedstock, process enzymes and yeasts, and assorted process chemicals.

Labor costs assume 10,000 hours per year at $6.00/hr. with fringes built into that hourly figure.

Plant burden assumes plant overhead.

Cost of goods in terms of feedstock is based on parity with the exception of waste potatoes. Even at $1.00 per HW, the potato farmer with 20,000 HW of waste potatoes will net an income feature of $20,000.

INCOME AND EXPENSE STATEMENT
(A PROJECTION)
AfuelsCORP and EAGLE farm-size still
(25 gal./hr., or 600 gal./da.)

REVENUE

(based on running 24 hrs./da., 5 days/wk.)

EtOH (1.5 US gal./HW potatoes x 20,000 HW x $1.00/US gal):	$ 30,000
(2.5 US gal./bu barley x 40,000 bu. per year x $1.00/US gal):	100,000
CO_2 x .03¢/lb. per production	4,375
WPTA Tax Credit (40¢/US gal. per gal/160P EtOH x 130,000 US gal.):	52,000
Coproduct Feeds	
(10,000 HW potatoes x $3.00/HW):	30,000
(40,000 bu barley x net $3.00/bu):	120,000
	$ 336,375

COST OF GOODS SOLD

Feedstock barley (40,000 bu. x $3.00/bu.):	$120,000
Feedstock potatoes (20,000 HW x $1.00 HW.):	20,000
Yeast and Enzymes	6,000
Misc. Chemicals	2,000
	$148,000

LABOR COSTS

Daily operation, 10,000 hrs. x $6.00/hr:	$ 60,000
Maintenance (5% of labor cost)	3,000
	$ 63,000

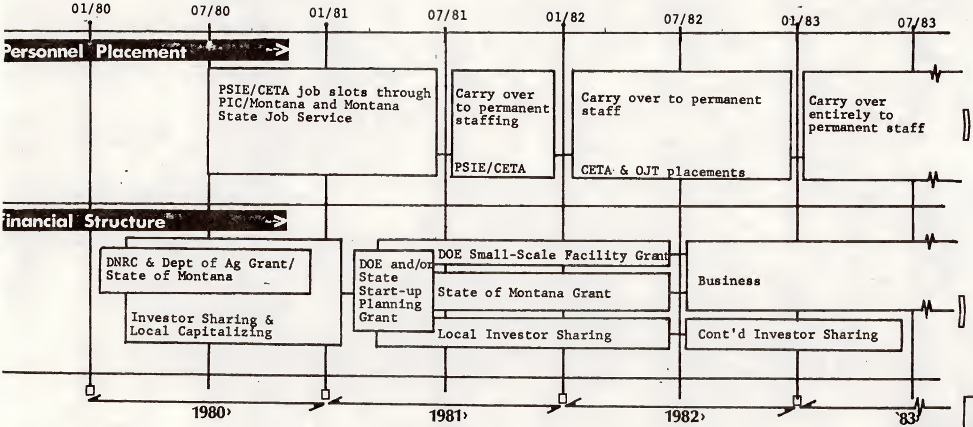
PLANT BURDEN

Plant write off ($100,000 plant cost divided by 5-year time period)	$ 20,000
Fuel handling costs (less than 400,000Btu per hour)	5,000
Electricity (15 AMP./hr. x .16¢/hr.):	960
	$ 25,960

PROJECTED GROSS PROFIT:	$ 99,415

Feedstock figures are based on Archer-Daniels-Midland parity figures.

WPTA Tax Credit is the Windfall Profits Tax Act which provides a 40¢/US gal. tax credit for each at-least 160P gallon of EtOH made which is viewed as income because of the favorable tax standing which shelters the gross profits of the corporation.



Lake County Resource Recycling Company
"America's Products for Energy"

LCRRC
Lake County Resource Recycling Company

SPECIAL NOTE:

The checklist is still being developed as of the date of this final report.

exhibit A

PROCESS RECORDING

AGRIFUELS OF
AMERICA CORPORATION

BATCH #1 SPOILED POTATOES

Date/24 hr time.	Observations/Initials
11:30 JULY 30	Potatoes ARE GROUND AND IN FERMONTATION TANK #1 (800# pot. 200 gal. WATER) FIRE IS STARTED AND TAKATHERM IS added AT this point (10 oz) pump WAS STARTED AND BEGAN agitation For 3 min.
2:45 AM July 31	TEMP has only INCREASED TO 104°F. FIRE BOX IS LOADED TO THE LIMIT. agitation FOR 5 min.
6:00 AM " "	TEMP RISING VERY slowly - HAVE had problems WITH FLUE on FIRE BOX must BOLT all CHIMNEYS
9:15 AM " "	TEMP 169° agitated. AT THIS point agitation MUST BE DONE BY HAND DO to THE FIBER-glass pump CASING
1:30 PM " "	TEMP 185° MASH SEEMS TO BE BOILING AT THIS TEMP (MAYBE A DEFECTIVE THERMOSTAT)
	MUST HOLD THIS TEMP FOR THE ENZYME TO BREAK STARCH DOWN TO sugar FOR A FEW MINUTES
3:15 PM " "	D.E. TEST SHOWS BREAKDOWN. WILL DECREASE TEMP TO 140° and ADD DYAZYME. Sulfic ACID ADDED TO ADJUST PH TO 4.5 (32 oz. DYAZYME)
8:00 PM " "	MEASURED ALCH POTENTIAL READING 0%
10:00 PM " "	" " " " 1%
10:45 PM " "	" " " " 2.5%
	AT THIS point IS SEEMS THAT WE HAVE ADDED TO MUCH WATER TO OUR MASH. THE MAKEUP OF Potatoes IS 75% H_2O TO 25% DRY MATTER WE SHOULD HAVE STAYED WITH THIS NATURAL RATIO. WILL DROP TEMP TO 85° FOR YEAST ADDITION

Process Feedstock: ____________

Inclusive Dates and Times: Fr: July 30, 80; 11:30 PM To: Aug 4, 80; 12:45 AM

PROCESS RECORDING

AMERICA CORPORATION

Date/24 hr time.	Observations/Initials
9:00 AM Aug 1	TEMP OF BREW 125° SEEMS TO BE COOLING AS SLOWLY AS IT HEATED. A [redacted] NEW COOKER IS A MUST. WE NEED TO BE ABLE TO COOL MASH WITHOUT ADDITIONAL WATER
2:30 PM " "	TEMP 82° BROKE UP TWO CAKES OF YEAST and dissolved THEM IN a BUCKET OF WARM WATER agitation WAS STARTED
7:00 PM " "	THE YEAST SEEMS TO BE WORKING RAPIDLY AGITATION BY PUMP 4 min TEMP 81°
10:00 PM " "	CO2 FUMES ARE EVIDENT IN MASH WE LIT A MATCH INSIDE OF FERMENTATION TANK ONLY SULFUR ON MATCH BURNED I THINK WE ARE doing SOMETHING CORRECT WILL LET FERMENT UNTIL MORNING.
11:00 AM Aug 2	TEMP 81° YEAST VERY ACTIVE THE MASH SEEMS TO BE HOLDING ITS OWN TEMP BUT WOULD BE MORE ACTIVE IF WE WOULD RAISE TEMP SLIGHTY. SMALL FIRE LIT. WILL ALLOW TO FERMENT UNTIL TOMARROW
7:30 P.M. Aug 3	YEAST ACTIVITY HAS CEASED FERMENTATION SEEMS TO BE COMPLETE WILL TRANSFER MASH INTO STILL
8:15 PM " "	MASH TEMP RISING VERY RAPIDLY IN STILL CONDENSER WAS FILLED WITH WATER
10:00 PM " "	TEMP 180° THE FIRST DROPS OF ALCOHOL HAVE BEEN PRODUCED
11:00 PM " "	TEMP 203° WE ARE STILL PRODUCING ALCH. THE STILL DOSNT SEEM TO BE PRODUCING
12:15 AM Aug 4	THE QUANITY THAT IT SHOULD BE FIRE HAS BEEN EXTING A TOTAL OF 9.5 gal OF ALCHOL HAS BEEN RECOVERED A BIT OVER 1 gal PER CWT Potatoes

Process Feedstock: ______

Inclusive Dates and Times: Fr: July 30, 80; 11:30pm; To: Aug 4, 80; 12:15 AM

PROCESS RECORDING

AGRIFUELS OF
AMERICA CORPORATION

Date/24 hr time.	Observations/Initials
Aug. 15th 10:00 AM	TEMP. 77° — STIRRED
11:30 AM	" 70° — STARTED SMALL FIRE TO MAINTAIN temp. Rotated Vigorously – Litmus Test 4.5°
12:30 P.M.	CLOSED FIRE DOWN. TEMP. 83° STIRRED Vigorously Looks very Good!
4:30 P.M.	Temp. 82° mash is working FINE. The pump WAS STARTED & The Slurry MOVED. Litmus P.H. Test – 5%
9:30 p.m.	Litmus TEST 4.5 – TEMP. 87° – Rotated MASH WE ARE NOW PREPARED FOR DISTILLATION PROCESS.
Aug 16th 1:30 A.M.	THE STILL IS Clogged. Closed DOWN UNTIL TOMMORROW DISTILLATION PROCESS BEGINS Still HAS BEEN FLUSHED AT Closure, LAST Night. Sig: glass PROVIDED NO READING because NOT ENOUGH GALLONS of BEER MIXTURE to fill it. THERMOMETER WAS REMOVED AND WAS USED TO ESTIMATE the AMOUNT of MASH IN THE TANK. THE PUMP
	WAS STARTED AND APPROX. 200 gals. OF MASH WAS PUMPED INTO STILL. THE fire WAS STARTED; HOSE HOOKED TO CONDENSER AND RESULTS AWAITED.
11:30 A.M.	A TEST WAS run FOR ALCOHOL IN THE MASH. It Showed between 5 AN 6%
12:30 A.M.	TEMP OF Still is 218° The Alcohol HASN'T GONE ABOVE 80 PROOF. AND, IN THE last 1/2 hour, it has DROPPED TO 75 PROOF.
	THE VALVE Controlling Cold water to the TOWER HAS BEEN Closed Down From Two full turns, to just ONE HALF TURN. TEMP. is being MAINTAINED AT 218°
2:30 p.m.	TEMP is 235° Hydrometer READING 30 proof Obviously, WE ARE NOT Doing Something Right But what??

Process Feedstock: BARLEY (GROUND) CONT.....	
Inclusive Dates and Times: Fr: __________, 80; __:__; To: __________, 80; __:__	

12:30 AM. Aug. 16th. — THE Biggest LABOR PROBLEM, Thus far, has been REMOVING the CANS OF OVERflow water from the CONDENSER. It Should be VENTED THRU THE WALL OR CONSERVED AS Hot water for Cleaning the equipment.

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PROCESS RECORDING

AGRIFUELS OF
AMERICA CORPORATION

Date/24 hr time.	Observations/Initials
Aug. 16th 3:00p.m.	TEMP 230° HYDROMETOR READING 50 proof FIRE is VERY hot but WE ARE NOT right!!!
3:30 pm.	Temp 230° Proof-Less than 10 Proof. THERE is NO Steam coming from the condenser AND the pipe conveying the Alcohol is Cool. Could this be PART of our problem?
4:30 pm.	TEMP 245° Eight Proof Alcohol – CONDENSER is being controlled. CAN'T figure what in the hell is wrong. Could it have been the beer mash? -MILES-
5:00pm. ★	SAME REPORT AS ABOVE. HOWEVER, WE MUST VENT THE CONDENSER OVERFLOW LINE OUTSIDE FIRST THING TOMORROW. -MILES-
6:00 pm.	Temp 210° NINETEEN Proof. The Condenser VENTS have been closed to ½ TURN. The fire Box has Been DAMPERED TO kill the fire. The slurry in the still will HAVE to wait until it cools enough for the pump to handle it without DAMAGE. This has been A very bad DAY DUE TO THE FACT WE couldn't figure what was wrong.
7:00 pm.	VENTED TOP RELEASE fitting to Allow hot Steam to vent. FIRE OUT. TEMP – 200°F. MASS of hot beer will EVENTUALLY Loose heat. EXPECT THAT overnight temp will steady out at 150° – 180° Conclusion: WATER MUST BE heated AND SLURRY REDUCED TO A MORE LIQUID MASS SO it CAN be agitated mechanically.

Process Feedstock: Barley (Ground Cont.....)

Inclusive Dates and Times: Fr:________, 80; __:__ To:________, 80; __:__

★ Aug 16th 5:00pm. During the DISTILLATION TIME ON This DATE, 400 gallons of Hot WATER WAS WHEELED OUTSIDE AND DUMPED.

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PROCESS RECORDING

AGRIFUELS OF
AMERICA CORPORATION

Barley

Date/24 hr time.	Observations/Initials
Aug 18/80 5^{00} PM	The Still & Red Cooker Was Purged & Cleaned. Thirty Gallons Of Barley Mash Was Drawn Off The Still & Yielded Very Low Alcohol.
6^{00} P.M	The Above Thirty Gallons Was Poured Back Into The Red Tank With The Original Mash And The Fire Was Strongly Increased.
Aug 18/80 9^{30} PM	The Water In Red Cooker Reached Boiling Point. Four Bushels Of Barley Was Added & Agitation Increased. Then The Heat Was Dampered Down
9^{45} PM	Four Ounces Of Takatherm Was Added & The Slurry Vigorously Stirred. The Heat Was Then Brought Down Slowly To 200 Degrees & Held There For Thirty Minutes.
Aug.18/80 10^{15} PM	Cold Water Was Added To Lower The Temp. & Two More Ounces Of Takatherm Was Mixed Into The Slurry. And The Temp Maintained For Fifteen Minutes.
10^{45} PM	Sugar Test Shows No Break Down, The Temp. Of The Cooker Was 175 Degrees
Aug 18/80 11^{45} PM	Temp. 180 Degrees. Test Showed A Breakdown Of The Starch.
11^{50} P.M.	Water Added To Slurry To Bring Temp Down 140 Degrees. Approx 60 Gals Of Water Added.

Process Feedstock: ____________________

Inclusive Dates and Times: Fr: Aug 18, 80; __:__; To: Aug 21, 80; __:__

PROCESS RECORDING

AGRIFUELS OF
AMERICA CORPORATION

Barley

Date/24 hr time.	Observations/Initials
Aug. 19/80 2:00 AM	Thirty Gallons Of Water Was Added Bringing The Total Amount Of Water To 120 Gallons. The Temp. Is 140 Degrees The P.H. Test Showed Point 4. A Quarter Cup Of Acid Was Added To Lower The P.H. To Point 4.5. One Half Cup Of Diazyme Added. Slurry Allowed To Set Until Tomorrow.
Aug. 19/80 10:00 AM	Four Ounces Of Diazyme Added. Sachrom-ater Reading Showed Dark Green.
Aug. 19/80 2:00 PM	Temp. Dropped To 100 Degrees. And Three Pounds Of Yeast Added. Pump Used To Agitate Slurry & Relieve CO² In The Lines.
Aug. 20/80 9:00 PM	Temp 70 Degrees. Fire Increased To Bring Temp To 80 Degrees. Test Shows 2% Sugar. Beer Therm 3½% Beer Fermenting Alcohol Mash.
Aug. 21/80 9:00 AM	Fire Started In Still & Slurry Pumped From Cooling Tank Into Still & Distillation Begun.
10 A.M.	Temp Of Still Raised To 230 Degrees
10:30 AM	First Alcohol Appeared. It Was Of Low Proof (105).

Process Feedstock: ____________________

Inclusive Dates and Times: Fr: __________, 80; __:__; To: __________, 80; __:__

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PROCESS RECORDING

AGRIFUELS OF
AMERICA CORPORATION

Barley

Date/24 hr time.	Observations/Initials
Aug 21/80 11:00 AM	To Increase Proof Of Alcohol Produced The Condenser Flow Was Increased And The Column Was Cooled To 173°
" " 11:30 AM	The Proof Of The Alcohol Rose To 170° Proof & Remained At This Temp. For Remainder Of The Batch Run.

Process Feedstock: ______________________

Inclusive Dates and Times: Fr: __________, 80; __:__; To: __________, 80; __:__

A Total Of Five Bushels Of Barley Was Distilled And One & One Half Gallons Of 170 Proof Alcohol Was Distilled.

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PROCESS RECORDING

AGRIFUELS OF
AMERICA CORPORATION

Molasses

Date/24 hr time.	Observations/Initials
8/26/80 TUES.	SlY Watch
10:30 AM.	After 24 of RUNNING water in 45 gallons of Molasses, Alcohol READING ON Sachrometer READS 17%
11:15 A.M.	34 MORE minutes of RUNNING WAter brought Sachrometer READING to 11%. I began heating tank. TOTAL GALLONS of water 200. TOTAL MOLASSES – 45 GALLONS – A 3:1 RATIO.
12:15 P.M.	TEMP of MASS is 85° will ADD YEAST AND BEGIN fermenting. 1 lb. YEAST will BE ADDED, ½ Dry + ½ CAKE.
12:45 pm	Temp is 87° At this point the 1 lb of YEAST WAS broke down in WARM WATER AND ADDED. THE HEAT BOX is Further Dampered to bring Solution to 80°
4:30 pm.	THE YEAST is working perfectly. Temp 93° No fire. Mash is maintaining its own heat.
8/27/80 WED. 10:00 AM	TEMP is 90° Yeast working WELL.
11:00 PM.	Barley Alcohol is in the Alcohol Still READY for its 2nd DISTILLATION. PRESENTLY WE ARE HEATING 50 gallons of H_2O to boiling. WE will ADD 300 lbs of WHEAT TO THE TANK. Molasses is fermenting Nicely, BEEROMETER MEASURED 8%. Will DISTILL MOLASSES TONight. THE HEAVI tractor 520 is IN the plant. Rick VanVoast is mounting AN ALCOHOL TANK, which Hilton WELDED together today, on the SIDE of the TRACTOR. When the tractor is IDEling on gasoline. Rick will SWITCH TO ALCOHOL, It TAKE APPROXIMENTALLY 2½ minutes to RUN gas out of tractor.

Process Feedstock: MOLASSES

Inclusive Dates and Times: Fr: 11:15 8/26/80, 80; 10:00 AM; To: 8/27/80, 80; __:__

CONCLUSION: Alcohol Fuel for Machine USE is possible perhaps EVEN on A Low grade Alcohol. Jets in cars will have to BE REAMED for ADDED fuel intake. Barley Alcohol Distilled out at 170–175 proof AND then dropped to 140 proof then on. WE CAN NOT UNDERSTAND why the still is not REACTING more efficiantly. Note: This Problem Was Overcome By The Addition Of A Thermometer To The Column. Which Provided Closer

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PROCESS RECORDING

AGRIFUELS OF
AMERICA CORPORATION

Batch #2 Spoiled Potatoes

Date/24 hr time.	Observations/Initials
Sept 3/80 10 PM	Ground 800 lbs Of Potatoes (Washed) To This Mash Was Added 200 Gallons Of Water & Was Mixed Into A Transferrable Slurry.
" " 11^{30} PM	Pumped Slurry From Hammer Mill Tank Into Cooker Tank ~~At~~ And PH Adjusted To 6.5 By Adding 4 oz. Of Lime To Raise The P.H. Factor.
Sept. 4/80 1^{00} AM	When Slurry Temp Rose To 200° Four Ounces Of Taketherm Was Added. (Enzyme) And Slurry Strongly Agitated.
" " 2^{30} AM	Fire Was Dampered & Slurry Cooled
" " 4^{00} AM	Temp Was A 180° & The Dextrose Equivalent Test Showed Approx. 3% Sugar. Water Was Added To Cool To 140° & 8 OZ. Of Diazyme (Enzyme) Was Added And The Slurry Vigorously Agitated.
" " 5^{00} AM	After One Hour We Showed 9% Alcohol Potential. Slurry Allowed To Cool Further For 10 Hours.
Sept 4/80 3^{00} PM	Temp 93.° Twelve Ounces Brewers Yeast Added & Allowed To Ferment

Process Feedstock: ______

Inclusive Dates and Times: Fr: Sept 3, 80; __:__; To: Sept 6, 80; __:__

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PROCESS RECORDING

AGRIFUELS OF
AMERICA CORPORATION

Date/24 hr time.	Observations/Initials
Sept 6./80/1^{00} PM	Slurry Has Separated, The Mash Has Sunk To The Bottom Of The Tank. The Beerometer Test Indicated 8% Alcohol.
" " 1^{20} PM	Fire Started In Still & Transfer Of Beer From Cooler To Still.
" " 2^{00} PM	Heat Raised In Still. Heat In The Colum Was Raised 163°. It Was Felt A Cooler Column Temp. Would Provide A Higher Proof Of Alcohol. This Was Proved To Be Correct.
" " 6^{00} PM	Following Above Procedure, We Produced 11 Gallons Of 165° Alcohol

Process Feedstock: ______

Inclusive Dates and Times: Fr: Sept 3 , 80; __:__; To: Sept 6 , 80; __:__

Controlling Column Temp. Proved Very Effective. The Altitude (3000') Probably Enabled Us To Make Alcohol At A Lower Colomn Temp.
Slurry Was Pumped From Still To A Drying Rack For Stock Feed

PROCESS RECORDING

AGRIFUELS OF
AMERICA CORPORATION ①

Barley

Date/24 hr time.	Observations/Initials
Aug. 12th 8^{00}/P.M. Aug 12th 10^{30}/P.M.	755 lbs BARELY mixture w/ 275 Gallons of H_2O. Fir applied to mixture until it is raised to 194° and maintained for 1 hour.
	DESIRED TEMP. WAS REACHED. AND 21 OUNCES OF "Takatheem" WAS ADDED. At this point the Slurry had to be adgitated manually until it became thinned out and could be handled by the pump. The mass began to gell at 150° Degrees. Then the mass was brought to 194 Degrees for one hour.
Aug 13th 12:00 mid.	Dratz took over. Agitated mixture manually. Still a heavy layer of barely on bottom 2/3rds of tank. Temp reading: 72°
12:30 AM	Agitated mixture temp 85°F
:00 AM	Agitated mixture temp. 95°F
1:30 AM	" " manually Temp 98°F
2:00 AM	" " " Power failure has began. No Temp. reading
4:00 AM	Slurry has been agitated every ½ hr. until now the power has returned. Temp reads. 110°F.
4:30 AM.	Stirred mash manually. Temp reads 110°F.
5:00 AM.	" " " " " 110°F
5:30 AM	" " " " " 122°F. Mash seems easier to stir.
6:00 AM.	Stirred mash manually, Temp reads 125°F
6:30 AM.	" " " " " 135°F
7:00 AM.	" " " " " 150°F
Aug. 13th 7:30 AM.	Dan Miles takes watch. Temp is 173°F stirred
8:00 AM.	Temp is 168° Note: Pump is unable to stir slurry. Agitation remains manual.
8:30 AM.	Stirred mash temp is 170°
9:00 AM.	" " ma.ually Temp is 171°
9:30 AM.	" " with rake - Pump inoperable Temp 174°
10:00 AM.	" " " " Temp 170° There is no wind - the draught is poor.
10:30 AM	Stirred with rake. Temp 173°. The wind picked up.
11:00 AM	Stirred with rake Temp. 176°
12:00 NOON	" " " " 180°
12:30 P.M	" " " " 180°
1:00 P.M.	" " " " 181°
1:30 P.M.	" " " " 183°
2:00 P.M.	" " " " 184°
2:30 P.M.	" " " " 191°
	*Stopped stoking fire and began dropping temperature in preparation for Diazyme addition. Will add the enzyme at 135 degrees

Process Feedstock: Barley (Ground)

Inclusive Dates and Times: Fr: 8:00 P.M., 80 Aug 12; To: 7:00 P.M., 80 Aug 14th

*The temperature will be dropped naturally.
ZOR

Date/24 hr time.	Observations/Initials
Aug 13th 3:30 P.M.	DRATZ TAKES OVER watch TEMP READS 160°F
4:00 P.M.	SAME " " 160°F
4:30 P.M.	SAME " " 155°F
5:00 P.M	SAME " " 150°F
5:30 P.M.	SAME " " 140°F
6:00 P.M.	SAME " " 142°F PH TESTED OUT AT 4.0 - 4.5 EST. LEFT MASH COOLING UNTIL:
10:00 P.M	DAN Miles WATCH - THE TEMP is 140° AND THE UNIT is Cooling nicely
10:30 P.M.	VAN VOAST WATCH. THE MASH SEEMS TO HAVE BROKEN DOWN CONSIDERABLY. THE EXTRA 128 gals of WATER should have BEEN ADDED at 2:30 P.M. TO DROP the temp to 135-140 DEGREES. The DIAZYME should have BEEN ADDED. WE would be MAKING ETOH By now. INSTRUCTIONS WERE Left on PREVIOUS page AND ON MILES LAB PAMPHLET. *
11:30 p.m.	SLY watch - Dropping TEMP to FERMENTATION LEVEL by the ADDITION of Water
12:00 Midnight	VANVOAST - UNPLUGGED pump + lines. The problem + our worries are over
Aug 14th 10:00 p.m	SLY AND VANVOAST - NO LOG READING SINCE MY LAST ADDITION AT 12:00 MIDNIGHT Aug. 13th. I ASSUME BY THE TEMP READING that the mash has NOT DROPPED ENOUGH to ADD YEAST.
10:30 p.m.	Sly - YEAST ADDED - AGITAION (MECHANICAL) is VERY SMOOTH
11:45 p.m.	Sly - Temp. is 97° I STIRRED + Agitated to ALLOW OXYGEN to mix with the YEAST AND Also ALLOW CO_2 GASES to rise easier + ESCAPE. I feel we should agitate vigorously for the 1st 12 or so hours of fermentation + then close her up tight with occasional Stirring every ½ hour. HOWEVER, the lines into the tank which agitate the mixture DO NOT ALLOW for EVEN + SMOOTH Agitation. It is suggested WE CONTINUE with our PRESENT action stirring every ½ hour by pump + manual until yeast HAS RUN its COARSE. Hilton will be up at 3:00 A.M. for Lentil harvest he will agitate mash then.
Aug 15th 8:00 AM	miles - TEMP. 80° All of the solid material has RISEN to the top of the tank. Agitated Both MECHANICALLY + with hand RAKE. MASS fermenting well
9:00 AM.	Temp 80° Agitate 5 min. ALL SEEMS TO BE PROGRESSING well

Process Feedstock: BARLEY (GROUND) CONT.......

Inclusive Dates and Times: Fr: ________, 80; __:__; To: ________,
80; __:__

022

Directions * 10:30 P.M. Aug 12th - TAKA-THERM was ADDED + agitation attempted. Pump will NOT MOVE SLURRY. PERHAPS AFTER MASH BREAKS DOWN MORE it will BECOME EASIER + WE CAN Agitate mechanically. MASH will gell AROUND 150°. IF BECOMES TO THICK, REDUCE HEAT TEMPORARILY. BRING MASH 194° for 1 hr. then cool to 140° by ADDING water. The DIAZYME CAN THEN be ADDED w/ PH of 4.2 ± .2 ADD 20 oz. of DIAZYME. Hold for 1 to 2 hours

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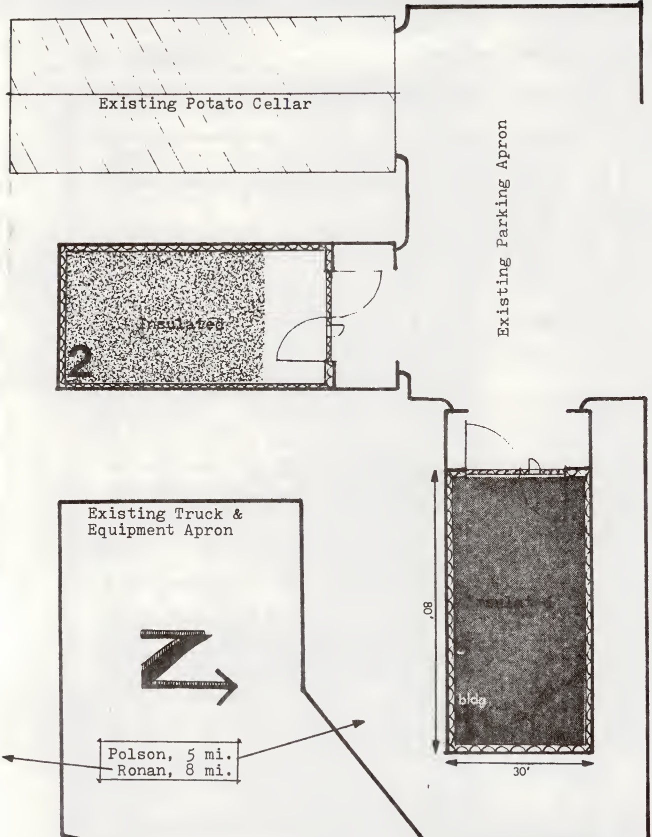
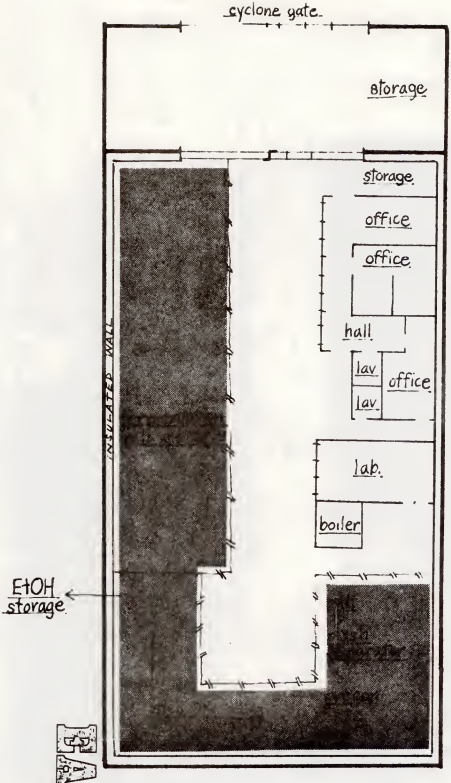
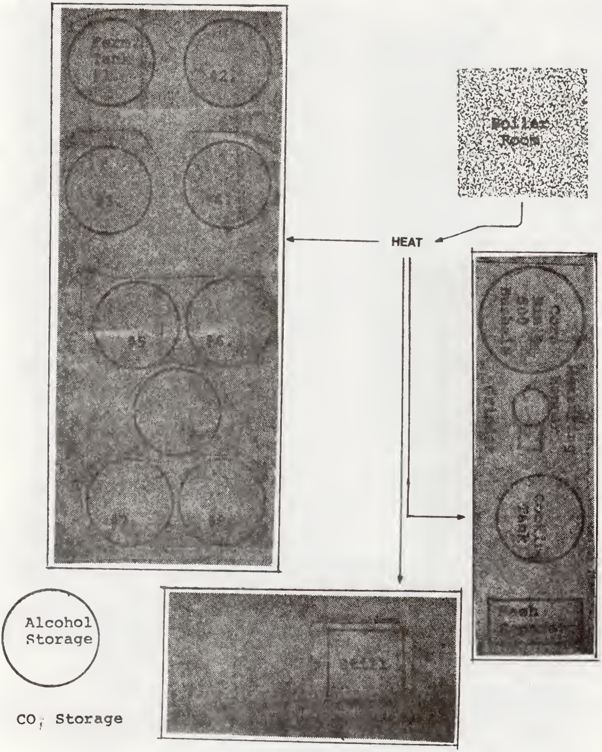
At 130° - cool to 82 to 86° ADD YEAST + FERMENT


Existing Potato Cellar
Existing Parking Apron
Insulated
2
Insulated
bldg
80'
30'
COUNTY ROAD (paved)
Existing Truck & Equipment Apron
N
Polson, 5 mi.
Ronan, 8 mi.
Distillation Bldg.
Coproduct Handling Bldg. (Feed Processing, etc)



EAGLE

BASIC FLOORPLAN
(Equipment areas shaded)
Depicted to approximate scale
in insulated building 80' x 30'
on Leonard and Hilton Hern Farm


Ferm. Tank #1
#2.
#3.
#4.
#5
#6.
#7
#8
Boiler Room
HEAT
Alcohol Storage
CO_2 Storage

DIGEST OF SUGAR-BEET PRODUCTION

Sugar beets were grown in fair abundance in Lake county during the 40s through beginning 60s. The last sugar beet crop raised in significant number was the crop of 1961.

The market for these beets was basically in Missoula at a regionally-based sugar-beet processing mill. The mill closed down in the early 60s.

Moise and the surrounding area was the center for sugar-beet production, although Arlee was also a planting center. Beets were raised as far north as the Hector Speckert ranch on the south shore of Flathead Lake. About 2,000 acres per year were devoted to sugar-beet production.

The basic cause of the decline of sugar-beet production and sugar-milling was the impact of cheap imported sugar.

The lower Flathead valley, then, being a seasonally warmer high mountain plateau, has been an ideal area in which to grow this sugar feedstock.

Most of the same growers who were growing beets at that time are now growing certified seed potatoes for Idaho and Washington delivery markets. The skills and equipment associated with beet production are largely still in place in the Mission valley (lower Flathead).

exhibit D

DIGEST OF SEED POTATO PRODUCTION

Seed potatoes have been grown in the Lake county area which has been an agricultural "quaranteen" area since production began in earnest in the early 60s.

Certified seed is grown for growers in Washington and Idaho and the famous "Idaho spud" is essentially grown from seed delivered by truck to western outlying states which are planted for a growing season and then harvested.

The advantage and reason seed is grown in the valley is that storage temperatures are seasonally cooler in the lower Flathead valley allowing for better storage of the dormant seed.

The past few years has witnessed a drastic increase in costs to the buyer-growers in the eastern outlying states due largely to increased transportation costs (the potatoes are shipped by truck).

An outfall of this has been the tendency in the past 5 years for the major growers to product an overfall of seed available for market. This overfall overall has amounted to nearly 20% of the entire crop. Several thousand tons are involved.

The ASCS has had a russet potato diversion program in recent years to divert some of the leftover crop into livestock feed. The program has worked this way: the FED buys leftover crops at about $1.75/HW and then processes and markets the feedstock. We have already made our case earlier in this study regarding adding the setp of EtOH production and still processing the leftover mash for ruminant. The continuance of this program is on a yearly basis and the grower doesn't really know from one year to the next whether the program will continue.

The amount of EtOH per potato HW is not all that great. But the ongoing fact that there are waste crops in a substantial projected productive amount leads to the conclusion that potatoes are a viable feedstock.

Growers normally truck away their waste potatoes due to quaranteen requirements that spoiled potatoes (they would rot if left in cellars through the summer) be properly disposed of. Growers would truck their overfall crops to our central distilling site on the Hern farm.

Exhibit E

AfuelsCORP NOTES ON ENZYMATIC HYDROLYSIS

Nothing disclosed is to be construed as a recommendation to use our products in violation of any patents. The information presented is believed to be accurate. However, said information and products are offered without warranty or guarantee except as to the composition and purity stated herein since the ultimate conditions of use and the variability of the materials treated are beyond our control.

Introduction: Traditionally, starchy raw materials were hydrolized by barley malt enzymes to fermentable sugars (glucose and maltose) for subsequent fermentation to EtOH.

Since 1960, microbial enzymes have been developed which satisfy the economic and technical requirements for malt replacement in EtOH production. Takatherm, from Miles Laboratories, is a thermostable alpha-amylase for starch liquefaction; Diazyme L-100, also from Miles Laboratories, is a glucoamylase for starch saccharification into fermentable glucose. Miles Laboratories and AfuelsCORP have arrived at the following conculsions of fact regarding both the process and the Miles products in particular, bearing in mind that the above disclaimer in small print applies:

- There are realized raw material savings
- Realization of increased EtOH yields is the ordinary outcome
- Convenience in handling and using around tanks is demonstrated and there is no expressed health hazard with the normal precautionary methods of handling which are customary with any heavy syrups with constituencies of this sort
- Packaging is such that the enzymes in bulk are well protected from heat and chill, when stored in a cool place, and are also protected from evaporation and the effect of light
- Standardized activity ratings exist for these and other similar products (such as those of Biocon, Inc., Norbert Haverkamp, Novo Laboratories and Scientific Products Co.)
- Thermostability of these enzymes is superior to malt amylase
- the glucoamylase (Diazyme L-100 in this case) has greater stability at lower pH values than malt amylase

Description Regarding Takatherm and Diazyme L-100: Takatherm is a liquid bacterial alpha-amylase of Bacillus licheniformis var. origin and is an endoamylase capable

Exhibit G

of randomly hydrolyzing the predominating a-D-1, 4-glucosidic linkages of starch. Consequently, the viscosity of gelatinous starch mashes is rapidly reduced. Takatherm converts starch, amylose and amylopectin to soluble dextrins and small quanities of glucose and maltose. Unlike malt amylase, Takatherm can liquefy mashes at temperatures above 194°F. Thus, this product and like products are extremely compatible with mash liquefaction via batch atmospheric (our method of cooking).

Diazyme L-100 is a liquid glucoamylase derived from a selected strain of Aspergillus niger var. Unlike the betamylase of malt, Diazyme L-100 is capable of hydrolyzing both the a-D-1, 6-glucosidic branchpoints and the predominating a-D-1, 4-glucosidic linkages of starch. The enzyme is an exo-glucosidase which liberates glucose units beginning at the nonreducing end of the starch chain. Diazyme is capable of achieving a complete breakdown of starch into fermentable sugar.

Properties:

	TAKA-THERM	DIAZYME L-100
Activity	170,000 MWU/g	100 DIAZYME Units/ml
Form	Non-viscous Liquid	Non-viscous Liquid
Color	Brown	Amber to Brown
Solubility	Completely miscible with water	Completely miscible with water
Specific Gravity	1.15 to 1.25 g/ml	1.15 to 1.20 g/ml

No activators or cofactors are required for these products.

Activity: One Modified Wohlgemuth Unit (MWU) is that activity which will dextrinize one milligram of soluble starch to a definite size dextrin in 30 minutes under the conditions of the assay.

One Diazyme Unit (DU) is that activity which will catalyze the production of one gram of dextrose in one hour under the conditions of the assay.

Effect of pH:

TAKA-THERM® has an optimum pH range of 5.5 to 7.0. In the presence of mash, 10 to 30% Dry Starch Basis (DSB), the enzyme demonstrates maximum hydrolysis over the range of pH 6.0 to 6.5 at 95°C. (203°F.). TAKA-THERM is stable in aqueous solution over the range of pH 5.0 to 11.0 at 25°C. (77°F.)

Optimum pH range	pH 5.5 to 7.0
Effective pH range	pH 5.0 to 8.0
pH stability	pH 5.0 to 11.0

DIAZYME L-100 has an optimum pH range of pH 3.8 to 4.5 at 60°C. (140°F.). Excellent activity is demonstrated over the normal pH range for distillery mashes. DIAZYME L-100 exhibits excellent stability at low pH surviving pH values as low as pH 2.0. The glucoamylase is less sensitive than malt to pH drops during fermentation.

Optimum pH range	pH 3.8 to 4.5
Effective pH range	pH 3.5 to 5.0
pH stability	pH 2.0 to 6.0

Effect of Temperature:

Effect of Temperature:

TAKA-THERM has a temperature optimum of 90° C. (194° F.) in the presence of 50 ppm calcium ion at pH 6.0. In the presence of mash (10 to 30% DSB) and sufficient calcium ion (50 ppm) the enzyme demonstrates excellent thermostability. Temperatures below 95° C. (203° F.) result in extended stability. Temperatures above 95° C. (203° F.) result in accelerated action with an increase in rate of enzyme inactivation.

Optimum temperature 90° C. (194° F.)
Effective temperature Up to 95° C. (203° F.)

Starch Tests:

STARCH TESTS:

Dextrose Equivalents (DE):

Either the Schoorl Method of Reducing Sugar Determination or the Lane and Eynon Procedure may be used to determine Dextrose Equivalents (DE). A copy of either or both procedures will be sent on request.

Iodine Method:

Prepare a stock iodine solution by dissolving 18 g of potassium iodide in approximately 700 ml of distilled water. Dissolve completely by swirling. Add 12.7 g of iodine and stir intermittently until dissolved. Quantitatively transfer to a one (1) liter volumetric flask and dilute to volume with distilled water. Store in an amber bottle. Prepare fresh weekly.

Prepare an iodine test solution by pipetting forty (40) ml of the stock iodine solution into a 100 ml volumetric flask. Dilute to volume with distilled water. Store in an amber bottle. Prepare fresh solution daily.

Tincture of iodine, obtainable from a local drugstore, may be used as an alternate iodine reagent if necessary. Prepare an iodine test solution by diluting one (1) part of 2% tincture of iodine with nine (9) parts distilled water. Store in an amber bottle. Prepare a fresh solution daily.

Batch Process: We used the atmospheric batch process although in the Eagle Still process we plan to convert to closed pressurized containment in hydrolysis and fermentation as part of a continuous connecting fermentation and distilling process. Miles Laboratories has prepared the following procedures. They worked out perfectly when followed to the letter.

Atmospheric Batch Liquefaction Process:

1. Prepare a 25% (w/w) grain mash by adding 17 gals. of water to 56 lbs. (one bushel) of milled grain (12 to 16 mesh). The final volume will be approximately 23.7 gals. since 56 lbs. of grain displaces its own weight in water (6.7 gal.). If starch is used, rather than grain, the mash should be adjusted with water to approximately 25 to 35% (w/w) solids.
2. Adjust the grain mash to pH 6.0 to 6.5 with a 10% lime slurry.
3. Add TAKA-THERM at 0.15% based on the dry starch content (DSB) of the milled grain. For corn this is 0.05 lb. (22.5 g) TAKA-THERM per 56 lbs. grain.
4. With continuous agitation, begin heating the mash. When the temperature of the mash reaches 66° C. (150° F.), the grain starch will begin to gelatinize and rapidly thicken. Continue heating at a rate such that the mash remains fluid and efficient agitation can be maintained. In the event that the mash is heated too rapidly, high viscosity will prevent efficient agitation. When this occurs, heating should be stopped until the viscosity is reduced.
5. Continue heating the mash to 90° C. to 100° C. (194° F. to212° F.) and hold until liquefaction is complete. This should require a hold period of approximately 30 to 90 minutes. Complete liquefaction can be judged by determining the reducing sugar content of the mash by an appropriate method. An acceptable method is Dextrose Equivalents (DE). When complete liquefaction is achieved, the mash will be 10 to 14 DE. An alternative test is to use an iodine solution to test filtered mash. A light yellow to light red color indicates complete liquefaction.
6. When liquefaction is complete, adjust the mash to 18% (w/w) solids with approximately 8 gals. of water and/or stillage. The final grain concentration should be 56 lbs. of grain in 32 gals. final volume.
7. Cool the mash to 57°C. to 60°C. (135°F. to 140°F.) and adjust the mash to pH 4.2 ± 0.2 with dilute hydrochloric acid.
8. Add 100 ml DIAZYME L-100 (10,000 DIAZYME Units/cwt. DSB) per 100 lbs. DSB. For corn this is 34 ml (0.086 lb.) DIAZYME L-100 per 56 lbs. grain. Hold the mash one to two hours at 60°C. (140°F.).
9. Cool the grain slurry to 28°C. to 30°C. (82°F. to 86°F.), add yeast and ferment.

ABOUT COMPANY MEMBERS

Daniel Miles Dan Miles, recently retired from the Heart Newspaper group, and his wife Bess have roots in Montana, Dan having spent his early years in the Divide and Butte areas. His career is marked with several distinctions and honors. At the present time he acts as Chair of the Board of Directors. Dan and Bess make their home in Polson.

Bill Dratz Bill is a Montana-native, born in Missoula and essentially reared in the Lake county area. After completing college at Antioch University, Bill worked for several social service organizations and political action groups. He and his wife Ferol reside on the east shore of Flathead Lake near Finley point.

Hilton Hern Hilton grew up in this area and farms on the Hern Farms in which he has an interest and which is co-owned by Leonard Hern, his father. Hilton has attended the University of Montana and he and his wife Suzanne, also a Montana native and an accomplished musician, live on the Hern farm.

Rick Van Voast Rick is an area native and grows wheat and barley on the Van Voast ranch, the largest Lake county grain spread, west of Polson. He also has a large hog operation which he manages with Stacy Young. Rick specialized in mechanical engineering and maintenance while in the Air Force.

Stacy Young Stacy has a broad and accomplished background in communications media and business management. She presently co-manages the Van Voast-Young hog operation and bills herself appropriately as a "...Montana hog

exhibit J

rancher..." She was reared in the Polson area and attended area schools.

Carlos W. Perry Carlos is an attorney who resides in California and Montana. His law practice provides the opportunity to specialize in Montana as a consultant and in California as an attorney. His broad background gives him a wealth of experience to draw upon, including a background in securities sales and business development. The Perrys currently make their home in the Bay Area of San Francisco, in California.

hire a stiller, obtain the supervision of a chemist or biologist and can have your EtOH produce analyzed by a chemistry lab specializing in fuels, it is not feasible to erect, maintain and run the plant yourself. Farmers simply by and large don't have the time. Farmers and ranchers having their own fermentation tanks and fuel storage tanks could ferment their own waste or set-aside produce and then distill the alcohol assuring quality, thereby producing the EtOH needed for year-around fuel needs, stored a year or six-months ahead at a time.

The company has designed a customized checklist for individuals and farm and ranch operations. At no cost or obligation our company team and our accountant will determine several factors and arrive at reasonable conclusions respecting your unique needs and presenting problems. We would consider acreage, estimated annual yield, your profit and loss statement, your log of fuel consumption and payments to jobbers, etc. We would also provide technical expert help with respect to your obtaining grants, low-interest direct and guaranteed loans, while they are available and according to your spoken wishes. The eventual results would be installing the EtOH fermentation tanks and distilling your own fuel. You could realistically be doing this by harvest time, in the fall of 1981.

* * *

In summary, what we have to offer the folks who are farming is INSURANCE ... you can become self-insured against the risk of partial or total disaster due to curtailment of fuel without which you could not produce what America and the rest of the world needs most: FOOD, TABLE MEATS and FIBERS.

* * *

Box 679 tel: 883-6102, or office 883-2677
Polson, MT 59860 (Dan Miles)

WELCOME TO LAKE COUNTY RESOURCE RECYCLING COMPANY and AGRIFUELS OF AMERICA CORPORATION!

LCRRC and its associate corporation was organized on March 2, 1980 by 6 Lake County citizens -- Dan Miles, Stacy L. Young, Hilton Hern, Carlos W. Ferry, Bill Dratz and Rick E. Van Voast.

* * *

This company was formed through mutual concern over America's dependency on OPEC cartel oil. It is generally felt by a majority of thoughtful citizens that as American based oil companies are forced to raise the price of petroleum distilates again and again, the results will be increasingly devastating to small- and large-scale farmers. Three of the company members are farmers and livestock raisers. Those have more than a passing concern. They daily live with the apprehension that foreign oil supplies could be cut off, producing a national state of emergency, in the process rendering the US farming industry "energy helpless" and the nation "food poor".

This company has been organized to assist farmers from being backed against the wall or rendered helpless by increasing fuel costs or an energy-based national crisis. IT IS OUR GOAL TO SEE THAT FARMERS [illegible] E FIRST BY BECOMING ENERGY SELF-RELIANT AND SELF-SUFFICIENT.

* * *

HOW DO FARMERS AND RANCHERS BECOME ENERGY SELF-SUFFICIENT?

Farmers and ranchers become self-reliant and more self-sufficient in part by utilizing surplus or waste farm produce and crop residue -- cull potatoes, cherries, wheat, barley, sugar beets, etc. Straight alcohol can then be used to operate field equipment and stationary farm motors.

HOW DO YOU PRODUCE ALCOHOL AND WHAT WILL IT COST?

You don't produce it directly. The company will produce it for you with quality control by using a mobile distillation unit. Production of your fuel would be on a cooperative basis. Farm and ranch operators install their own fermentation units and fuel storage tank(s) and this plan allows keeping construction and production costs to a feasible minimum. The fermenting installations will pay for themselves as a short-term capital investment, and "pays its own way..."

[illegible] 6 months of field research into EtOH production, the [illegible] concludes it is not feasible for farmers and ranchers to operate their own alcohol plants [illegible] the following reasons, among others:

- -- EtOH production represents, on the whole (fermentation tanks, stills, etc.), a significantly large capital investment.
- -- The energy output for the distillation of EtOH is relatively high and can vary due to several foreknown fixed factors.
- -- There is an absolute need for round-the-clock surveillance (monitor the instrumentation, security, critial path handling etc.)
- -- Extensive practical skills and a working experience in the art of EtOH production is essential.
- -- Management techniques and precise record-keeping are a must.
- -- Government regulations must be observed and adhered to and extensive reporting is required.
- -- Were you to employ stillers or other necessary workers, crew costs would be expensive and not provide year-around employment.
- -- Skilled technical assistance in this field is hard to find.

Our cooperative concept impacts and solves these potential problems.

Unless you are retiring from the farming industry or have free time or have sufficient income to

August 28, 1980 -- ALCOHOL FUEL OPEN
HOUSE AND DEMONSTRATION

Guest List

Name/Address/Capacity

1. Kathleen Young, Polson; spectator
2. Don Young, Polson; realtor
3. Skip Relinger; spectator
4. N. B. Coppedge, Polson; director, 1st Citizens Bank
5. James E. Bruekmann, Polson; farmer
6. Charles Bruekmann, Polson; farmer
7. Irene Baker, Bellflower, California; farmer
8. John T. Dolty; spectator
9. Tim Gallagher, Helena; State of Montana
10. Elwin Bennington, Polson; spectator
11. Alvin E. Sloan, Pablo; Confederated Salish & Kootenai Tribes of the Flathead reservation, Manpower Office
12. Tom Pablo, Pablo; Chairman, Tribal Council, Confederated Salish and Kootenai Tribes
13. Gene Marcille, Polson; director, Community Development Corporation
14. R. S. Smiut, Missoula; spectator
15. Gary Decker, Missoula; president, Energy Options, Inc.
16. Wally Weivoda, Polson; investor
17. Paul Fugelberg, Polson; Editor, "Flathead Courier"
18. Bill Hocker, Jr., Ronan; farmer
19. Jim Manley, Polson; attormey
20. Starkel Bros., Ronan; ranchers
21. Keith Rennie, Polson; attorney
22. Mac Schaffer, Bigfork; orchardist
23. Richard and Lena Thurston, Polson; orchardists
24. Jeannie Thurston, Polson; orchardist
25. Don Richardson, Noxon; farmer
26. John K. Aguire, Thompson Falls; stiller
27. Dan and Alton Callahan, St. Ignatius; ranchers
28. Ted Schwinden, Helena; farmer and Lt. Governor
29. Ron Martin, Swan Lake; businessman
30. Oliver R. Dupuis, Polson; businessman and farmer
31. Dave Starkel, Ronan; farmer
32. Leila Roberts, Charlo; farmer
33. Gail Anderson, St. Ignatius; farmer
34. Bill Roberts, Charlo; farmer
35. Ralph Salomon, Ronan; farmer
36. Henry Normandeau, Ronan; farmer
37. Larry Mueller Farms, Ronan
38. Ed Bratton, Ronan; farmer and county extension agent
39. Neil Hurst, Pleasantown, California; businessman

exhibit K

40. Andrea Staves, Polson; orchardist
41. Alexander Vasha, Elmo; farmer
42. Al Osher, Polson; scientist and orchardist
43. Menno Miller, Polson; farmer
44. Robert Miller, Polson; farmer
45. William Hocker, Ronan; farmer
46. A. L. McGuire, Pablo; farmer
47. Faye Johnson, Ronan; farmer
48. Clancy Bras, Polson; farmer
49. Clarence Bras, Polson; rancher
50. Steve Feitveit, Missoula; KECI and KCFW Television
51. Gordon Harding, Polson; Polson Stove Shop
52. Ed Starkel, Ronan; rancher
53. Roger Starkel, Ronan; rancher
54. Leonard D. Hern, Polson; farmer
55. Francis Perry, Polson; spectator
56. Carlos Perry, Polson; attorney and businessman
57. Alice and Earl Pettijohn, Polson; spectators
58. Thomas C. Hamm, Polson; businessman
59. Carol Sherrick, Polson, businessperson
60. Merl Axtell, St. Ignatius; rancher
61. Boomer Slothouer, Missoula; "Daily Missoulian"
62. Jack Gunderson, Helena; Montana Department of Agriculture
63. Mr. and Mrs. Leo Burnett, Polson; farmers
64. Ailene Pierce, Ronan; deputy county extension agent
65. Jim Peace, Polson; farmer
66. Linda Harbine, Polson; rancher
67. Larry Martin, Colorado; spectator
68. Adam Kirsch, Ronan; Ronan State Bank
69. Robert E. Carson, Polson; spectator
70. Andy Groen, Chatfield, Minnesota; farmer
71. Evelyn Brooke, Polson; spectator
72. Chris Perry, San Francisco, California; spectator
73. Howard Draney, Polson; spectator
74. Sam Watern, Polson; spectator
75. John Slokes, Ronan; rancher
76. Ron Houtell, Charlo; farmer
77. Leonard and Denise Kozioe, Billings; businesspeople
78. Alvin Shaw, Ronan; farmer and businessman
79. Charles W. Mangels, Polson; farmer
80. Art Mangels, Polson; farmer
81. Allen Johns, Ronan; Malone Irrigation
82. Greg Allite; spectator
83. Alice Fite, Polson; Malone Irrigation
84. Don Koberg, Ronan; farmer
85. Cal Hubbard, Ronan; Editor, "Ronan Pioneer"
86. Tom Livers, Helena; Department of Natural Resources
87. Dugan Caffrey, Polson; farmer
88. C. E. Caffrey, Jr., Polson; farmer
89. Ken Caffrey, Polson; farmer
90. Kathryn Hines, Ronan; US Department of Agriculture

91. Robert Hamel, Ronan; US Soil Conservation Service
92. Belle Malone, Ronan; Malone Irrigation Service
93. Stacy L. Young, Polson; farmer
94. Scott Walher, Polson; spectator
95. Walter Mangels, Polson; farmer
96. Ralph Giffin, Polson; businessman
97. Tom Montgomery, Missoula and Florence; USDA
98. Ralph Wiggin, Polson; businessman
99. Fred Furmann, Polson, businessman

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roughly half of those in attendance did not sign the guest register

PABLO — Some Lake County farmers think they've found a way to wave a magic wand over a ton of rotten potatoes and turn the mess into money.

The magic wand is a still that converts agricultural waste products into fuel for farm machinery.

And it doesn't take someone with a crystal ball to know fuel is the same thing as money in the bank on today's farms.

The six Polson-area residents, Bill Dratz, Hilton Hern, Dan Miles, Carlos Perry, Rick Van Voast and Stacy Young, unveiled the system Aug. 28 on the Leonard Hern ranch about four miles south of Polson.

Lt. Gov. Ted Schwinden, who Miles said was "instrumental" in helping the group get funding for the project, was one of the speakers at the affair that drew a machine-shed full of the curious ranchers and businessmen to the ranch.

At the demonstration, Van Voast started a tractor on gasoline then switched it over to the alcohol.

The rough cough of the machine running on gasoline turned into a purr when Van Voast flipped the switch and sent 160-proof to 170-proof alcohol into the machine's carburetor.

Then he switched off the machine and started it using only alcohol. The tractor had no modifications to use alcohol, Van Voast said. The group plans experiments to determine the effects long-term use of alcohol may have, and any engine modification which may have to be made.

The group eventually plans to put the still on a flatbed truck and show farmers in the area how their waste crops can be turned into fuel.

They envision a cooperative effort with farmers putting their agricultural residue into the fermentation tanks.

When the fermentation stage is complete, the truck-mounted still would make its rounds to top off the process.

Payment to the farmers would be based on the effort they expend in readying the mash for distillation. Some farmers might opt, for example, to only provide fermentation tanks. Others might nurse the mash through the fermentation process so it would be completely ready for distillation without any help from owners of the still.

The process is relatively simple, Van Voast said.

Waste crops are ground up and placed, usually with the addition of some water, in the fermentation tanks.

The mixture is then heated to 200 degrees and enzymes are added to break down the starch.

The mixture is stirred while it cooks for three hours. Then more water is added to cool the mixture down to 140 degrees and another enzyme is added. After the starch is completely broken down into sugar, yeast is added to turn it into alcohol.

The process from grinding to alcohol takes about 60 hours, Van Voast said.

At this point, the mixture or mash, is ready to be distilled. The liquid is pumped into the still where it is heated, changing to water vapor and alcohol vapor.

The vapors rise through a column at the top of the still. The column is filled with marbles. When the water vapor hits the cooler marbles it condenses and falls back down. The alcohol condenses at a lower temperature than water so it remains in vapor form and continues to rise.

At the top of the column, cool water is circulated through copper tubing to make sure the water vapor condenses and only the alcohol is siphoned off.

This alcohol is usually 160 to 170 proof, Van Voast said. The strength of the alcohol depends on the amount of water that is left after the distillation process.

Studies have shown that a ton of potatoes, for example, yields about 23 gallons of alcohol after the process, co-owner Perry said.

It takes fuel to haul the potatoes to any central distillery, he said, and that cuts into any profit or savings a farmer may make by distilling his waste products.

The group wants to avoid this problem by bringing the distillation plant to the farmer, he said.

"This is not a get-rich-quick business for anybody," Perry said. Basically, it is just subsidizing farmers in the valley, helping them get rid of their waste crops and giving them some cash, he said.

The project was conceived last winter when the group got together to look for a way to clean up the Mission Valley while possibly producing some form of energy as a byproduct. They formed the Lake County Resource Recycling Company.

They applied for a small-scale renewable energy grant through the Renewable Energy program and another grant through the Food and Fuels program, sponsored by the state Department of Natural Resources and state Department of Agriculture. They received $2,500 from each program to match their own $5,000.

The group began developing the system in a hit-and-miss manner.

"We've made the mistakes, but we've learned a lot," Miles said. They built everything themselves, except the still, which they bought for $20 from a company in Washington, Van Voast said.

The Renewable Energy project was started in 1976 with money from the coal severance tax. The program receives about 2.5 percent of the tax and uses the money to award grants for small-scale projects in such fields as solar, small-head hydroelectric, wind, biomass, wood and geothermal power.

The program has provided funding for projects ranging from a solar space and water-heating system in Hamilton to a gasohol distillation plant in Glasgow. One grant went to White Sulphur Springs to build a geothermal-heated bank.

The Department of Natural Resources and Conservation has awarded more than $2.6 million in 159 grants so far. The program is seeking applications for further projects.

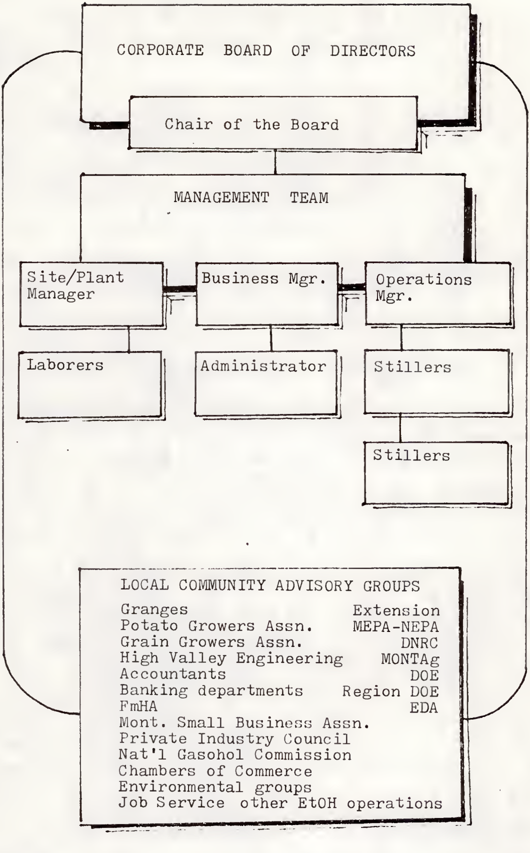

CORPORATE BOARD OF DIRECTORS
Chair of the Board
MANAGEMENT TEAM
Site/Plant Manager
Business Mgr.
Operations Mgr.
Laborers
Administrator
Stillers
Stillers
LOCAL COMMUNITY ADVISORY GROUPS
Granges
Potato Growers Assn.
Grain Growers Assn.
High Valley Engineering
Accountants
Banking departments
FmHA
Mont. Small Business Assn.
Private Industry Council
Nat'l Gasohol Commission
Chambers of Commerce
Environmental groups
Job Service
other EtOH operations
Extension
MEPA-NEPA
DNRC
MONTAg
DOE
Region DOE
EDA

exhibit M

BRIEF GUIDELINES REGARDING MOTOR MODIFICATIONS

For conversion to operate on ethyl alcohol:

1. Enlarge the carburetor metering jets by the ratio of 1.27 times the jet diameter for gasoline use.
2. Provide heat energy to the intake manifold for starting and full throttle acceleration.
3. Drain fuel system of all gasoline and make certain system is clean and dry.
4. Refill with ethanol, start engine and adjust idle mixture and idle speed when engine is warm.

Higher Heating Value		
BTU/lb @ 68°F	20,260	12,800
BTU/gal	124,800	
Heat of Vaporization		
BTU/lb	150	396
BTU/gal	900	3,378
Octane Ratings		
Research	91-105	106-108
Pump (Ron+Mon)/2	86-90	98-100
Flammability Limits (% by Vol in Air)	1.4-7.6	4.3-19.0
Specific Heat BTU/lb -°F	0.48	0.60
Autoignition Temp (°F)	430-500	685
Flash Point (°F)	-50	70
Coefficient of Thermal Expansion @ 60°F & one Atm	0.0006	0.00112

exhibit N

MONTANA NOTICE 5-PA-239

COUNTY LAKE

A Basic Data

1 Number of ASCS farms (of record) 972

2 Number of NCA farms (greater than zero) 365

3 Number of "zero" NCA farms (with 1980 established yields) 40

4 Number of "zero" NCA farms (with no 1980 established yields but issued an ASCS-476) 260

5 Number of farms reporting at "high" level 133

6 Number of farms reporting at "low" level 113

B Irrigation Data

		1980 acres reported
1	Crops	
	a. Wheat - irrigated	4698.9
	b. Barley - irrigated	6147.3
	c. Corn - irrigated	382.8
	d. Grain Sorghum - irrigated	

2 Total estimated irrigated acreage in county 120,000

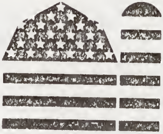
C Crop Data (from ASCS-578 and photocopies, also estimates)

	Crops	Acres Reported	Estimated	Total
1.	Wheat - grain	10112.0	10,000	20,112.0
	other			
2.	Barley - grain	8397.7	10,000	18,400.0
	other	92.9	200.0	293.0
3.	Corn - all	382.8	717.0	1100.0
4.	G. Sorghum - all			
5.	Oats - grain	1658.1	3000	4658.0
	other	70.0	200.0	270.0
6.	Rye - grain			
	other			
7.	Dry edible beans			
8.	Sugar beets			
9.	Flax			
10.	Sunflowers	16.5	50.0	67.0
11.	Soybeans			

exhibit (O)

5-9-80

Crops	Acres Reported	Estimated	Total
12. Non-NCA crop such as ~~[illegible]~~, triticale, potatoes, faba beans, spetz, etc.			
Crop Potatoes	1230.0	600.0	1830.0
Lentils	759.0	1000.0	1759.0
Cowpeas	11.2	0	11.2
Alfalfa	11,034.5	15,000	26,000.0
Clover	42.7	50.0	93.0
13. Tame grasses, legumes - hay or pasture	13,092.0	25,242	37,334.0
14. Other non-NCA crops for forage, hay, etc.	19,015.1	62,196.0	81,211.0
15. Summer fallow, idle	3853.9	3000.0	6853.0
16. Totals	68786.7	131,255.0	200,000.0
17. Total county cropland		200,000	



COMPARISON OF RAW MATERIALS FOR ETHANOL PRODUCTION

Raw Material	Gal Ethanol	Protein Yield	%Protein dry
Corn	2.6/bu	18lb/bu	29–30
Wheat	2.6/bu	20.7/bu	36
Grain sorghum	2.6/bu	16.8/bu	29–30
Average starch grains	2.5/bu	17.5/bu	27.5
Potatoes(75% Moist) 12-14	1.4/cwt	14.8/cwt	10
Sugar beets	20.3/ton	264/ton	20
Molasses (50% sugar)	0.4/gal	68/ton	20

Source: National Gasohol Commission.

PERCENT SUGAR AND STARCH IN GRAINS

Grain	%Sugar	%Starch
Barley	2.5	64.6
Corn	1.8	72.0
Grain sorghum	1.4	70.2
Oats	1.6	44.5
Rye	4.5	64.0
Wheat		63.8

Source: *Composition of Cereal Grains and Forages,* National Academy of Sciences publication.

exhibit P

WATER, PROTEIN, AND CARBOHYDRATE CONTENT OF SELECTED FARM PRODUCTS

Crop	%Water	%Protein	% Carbohydrate
Apples, raw	84.4	0.2	14.5
Apricots, raw	85.3	1.0	12.8
Artichokes, French	85.5	2.9	10.6
Artichokes, Jerusalem	79.8	2.3	16.7
Asparagus, raw	91.7	2.5	5.0
Beans, lima, dry	10.3	20.4	64.0
Beans, white	10.9	22.3	61.3
Beans, red	10.4	22.5	61.9
Beans, pinto	8.3	22.9	63.7
Beets, red	87.3	1.6	9.9
Beet greens	90.9	2.2	4.6
Blackberries	84.5	1.2	12.9
Blueberries	83.2	0.7	15.3
Boysenberries	86.8	1.2	11.4
Broccoli	89.1	3.6	5.9
Brussels sprouts	85.2	4.9	8.3
Buckwheat	11.0	11.7	72.9
Cabbage	92.4	1.3	5.4
Carrots	8.2	1.1	9.7
Cauliflower	91.0	2.7	5.2
Celery	94.1	0.9	3.9
Cherries, sour	83.7	1.2	14.3
Cherries, sweet	80.4	1.3	17.4
Collards	85.3	4.8	7.5
Corn, field	13.8	8.9	72.2
Corn, sweet	72.7	3.5	22.1
Cowpeas	10.5	22.8	61.7
Cowpeas, undried	66.8	9.0	21.8
Crabapples	81.1	0.4	17.8
Cranberries	87.9	0.4	10.8
Cucumbers	95.1	0.9	3.4
Dandelion greens	85.6	2.7	9.2
Dates	22.5	2.2	72.9
Dock, sheep sorrel	90.9	2.1	5.6
Figs	77.5	1.2	20.3
Garlic cloves	61.3	6.2	30.8
Grapefruit pulp	88.4	0.5	10.6
Grapes, American	81.6	1.3	15.7
Lamb's-quarters	84.3	4.2	7.3
Lemons, whole	87.4	1.2	10.7
Lentils	11.1	24.7	60.1
Milk, cow	87.4	3.5	4.9
Milk, goat	87.5	3.2	4.6
Millet	11.8	9.9	72.9
Muskmelons	91.2	0.7	7.5
Mustard greens	89.5	3.0	5.6
Okra	88.9	2.4	7.6
Onions, dry	89.1	1.5	8.7
Oranges	86.0	1.0	12.2
Parsnips	79.1	1.7	17.5
Peaches	89.1	0.6	9.7
Peanuts	5.6	26.0	18.6
Pears	83.2	0.7	15.3
Peas, edible pod	83.3	3.4	12.0
Peas, split	9.3	1.0	62.7
Peppers, hot chili	74.3	3.7	18.1
Peppers, sweet	93.4	1.2	4.8
Persimmons	78.6	0.7	19.7
Plums, Damson	81.1	0.5	17.8
Poke shoots	91.6	2.6	3.1
Popcorn	9.8	11.9	72.1
Potatoes, raw	79.8	2.1	17.1
Pumpkin	91.6	1.0	6.5
Quinces	83.8	0.4	15.3
Radishes	94.5	1.0	3.6
Raspberries	84.2	1.2	13.6
Rhubarb	94.8	0.6	3.7
Rice, brown	12.0	7.5	77.4
Rice, white	12.0	6.7	80.4
Rutabagas	87.0	1.1	11.0
Rye	11.0	12.1	73.4
Salsify	77.6	2.9	18.0
Soybeans, dry	10.0	34.1	33.5
Spinach	90.7	3.2	4.3
Squash, summer	94.0	1.1	4.2
Squash, winter	85.1	1.4	12.4
Strawberries	89.9	0.7	8.4
Sweet potatoes	70.6	1.7	26.3
Tomatoes	93.5	1.1	4.7
Turnips	91.5	1.0	6.6
Turnip greens	90.3	3.0	5.0
Watermelon	92.6	0.5	6.4
Wheat, HRS	13.0	14.0	69.1
Wheat, HRW	12.5	12.3	71.7
Wheat, SRW	14.0	10.2	72.1
Wheat, white	11.5	9.4	75.4
Wheat, durum	13.0	12.7	70.1
Whey	93.1	0.9	5.1
Yams	73.5	2.1	23.2

Source: *Handbook of the Nutritional Contents of Foods,* USDA.

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